SPECIAL REPORT ON MAINTENANCE

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OIL, GAS AND PETROCHEMICAL PROCESSING

Petroleum Refiner

MARCH
1959

STATISTICS SERIES

How Good Are Your Calculations? 189

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Cut Your Employe Turnover Rate 245

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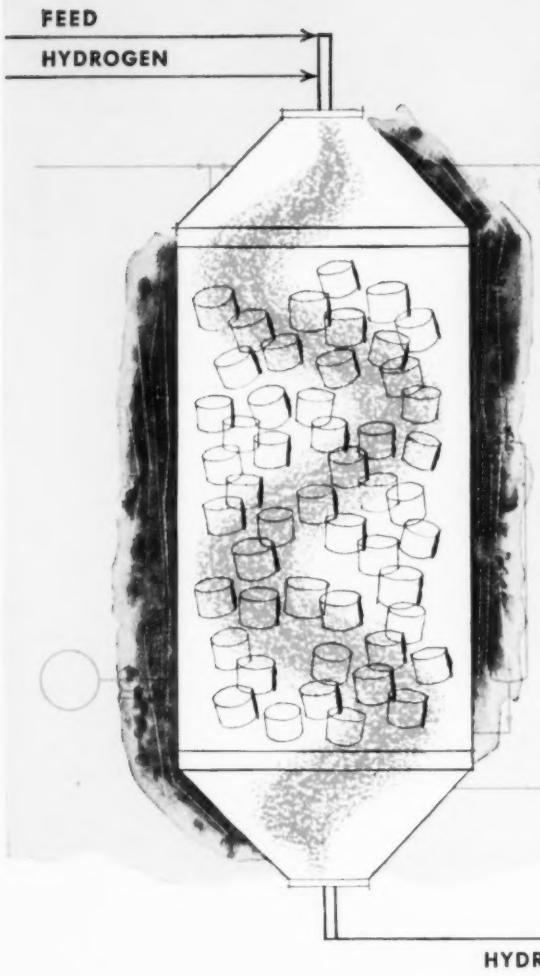

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Volume 38, No. 3 March, 1959

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Petroleum Refiner
OIL, GAS AND PETROCHEMICAL PROCESSING

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A Quick Look at This Issue

These handy digests permit checking the articles you want to read first. ☑

SPECIAL MAINTENANCE REPORT

☐ **1959 Maintenance Cost Survey . . .** In an effort to establish a maintenance cost yardstick, PETROLEUM REFINER made an industry-wide survey of maintenance costs of typical refining and petrochemical units, and natural gasoline plants. Now, here are the results, completely analyzed with respect to the trends in the costs of maintaining these units. How does your plant compare? Page 136.

☐ **Six Steps To Equipment Cost Control . . .** Maintenance expenditures are becoming a larger part of the process industry's operating costs. By controlling equipment costs, you can forecast your maintenance budget on factual data. Take a look at Du Pont's system on Page 139.

☐ **Day-to-Day Maintenance Labor Problems.** The steward and the foreman are the front line combatants on everyday labor problems. If you educate them on management problems, a lot of top supervisory headaches can be saved. Page 143.

☐ **In Maintenance Labor—Craft Barriers Are On the Way Out . . .** The trend is to a breakdown of jurisdictional roadblocks for smoother intercraft relationships. Contract maintenance tends to push this trend along, and some refineries are organizing their maintenance programs along contract maintenance lines. Page 148.

☐ **Can Consultants Help Your Maintenance Program? . . .** He can review your checks and balances and look critically at your methods with an outside eye. He is not the old efficiency expert; his studies will quickly indicate the degree of skills and techniques necessary to maintain a plant at the lowest cost. For complete details, turn to Page 153.

Please Turn Page ➔

Another Example of Skill With Alloys

Graver's skill with alloys is demonstrated by a long and successful record of fabricating aluminum tank cars for the Union Tank Car Company, North America's largest tank car fleet owner.

Aluminum isn't always the easiest metal to weld. In fact, some of the aluminum alloys are downright pesky at times. But never so much so that Graver can't handle them competently.

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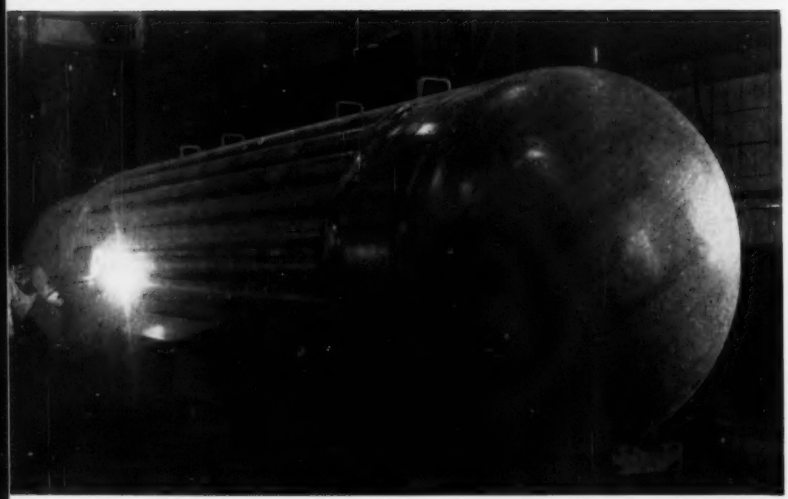

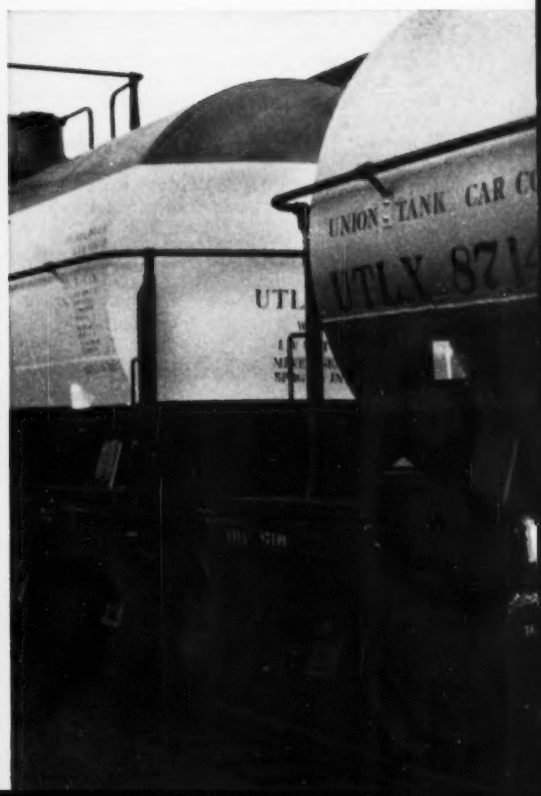

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A Quick Look at This Issue . . .

☐ **Good Housekeeping Can Pay For Itself . . .** A good housekeeping program is one prerequisite to an efficiently operated refinery. Without it, you're asking for accidents, loss of product and higher costs. To improve your housekeeping, turn to **Page 156.**

☐ **Computers Cut Record Keeping Costs . . .** Only recently did refiners discover they could make large savings by using computers to solve maintenance record keeping problems and calculations. To see how this is done, turn to **Page 159.**

☐ **Planning-Scheduling Cut Plant Costs . . .** Chemstrand decided three years ago to cut maintenance costs—and they did so. The first step was to establish a planning and scheduling group. This is the major factor in the cost reduction. For a look at how they accomplished this, turn to **Page 161.**

☐ **Spring Solves Soft Packing Problems . . .** Soft packing applications have taken a long step forward through the use of a spring in the stuffing box. Packing life can be greatly extended, maintenance costs cut and downtime for packing failures practically eliminated by adopting these ideas. For complete details, turn to **Page 167.**

☐ **Talks Reveal Dissimilar Maintenance Viewpoints . . .** Editor's notes taken during a round table discussion on refinery maintenance indicates that there is a wide variation in maintenance practices among refineries. Who's right? For all sides of the story, turn to **Page 170.**

☐ **Air Conditioning Cuts Vessel Maintenance Costs . . .** Portable air conditioners providing cool air inside process vessels are increasing maintenance work output. This, of course, results in a cheaper, safer, faster job. Here are two case histories that illustrate the effectiveness of these units. For complete details, turn to **Page 171.**

☐ **Monitoring Justifies New Unit . . .** To make an ethane-propane recovery unit pay out, La Gloria had to dig deeply into advanced monitoring systems. For the story on how they went about designing the unit, turn to **Page 173.**

☐ **Get More Cracker Feed from Residua . . .** A new and improved deasphalting process is being used at Humble's Baytown refinery to recover catalytic cracking feed stock from crude residua. For the complete story from conception, through the laboratory, to the improved process, turn to **Page 177.**

☐ **Find Fuel/Air Ratios Graphically . . .** For quick and reasonably accurate air/fuel ratios, this chart simplifies rigorous stoichiometric calculations. Using only a simple exhaust gas analysis and fuel hydrogen-carbon ratio, you can quickly handle many rapid determinations of this combustion problem. This is for your working notework so turn to **Page 181.**

☐ **Mechanical Drive Steam Turbine Application . . .** The principle of the mechanical drive steam turbine is old. It is simply the conversion of heat to mechanical energy. But, by using these new ideas on turbine selection, you can get lower initial costs and lower fuel costs. For complete details, turn to **Page 185.**

☐ **How Good Is The Answer You Report (Part 1) . . .** Basic statistical methods are useful in the analysis of engineering data. Here is the first of two articles which will review some simplified techniques of reporting data. **Page 189.**

☐ **The Hydrocyclone, A New Process Tool . . .** The cyclone has long been used to separate solid catalysts from gases and vapors. But now consider the centrifugal separation principle for liquids. **Page 193.**

☐ **Determine Asphalt Blowing Kinetics . . .** The art of air-blowing asphalt still remains, but this article gets the technology on a firmer basis. **Page 197.**

☐ **Evaluate Pollution Control This Way . . .** requires establishing some form of rating program for things to be done and accomplishments. For the method developed and used by Humble, turn to **Page 201.**

☐ **Remove and Recover Acetylene . . .** Here's a scheme for recovering acetylene from ethylene plant rich gas streams which could start you into acetylene petrochemicals. For design data and material balances, turn to **Page 209.**

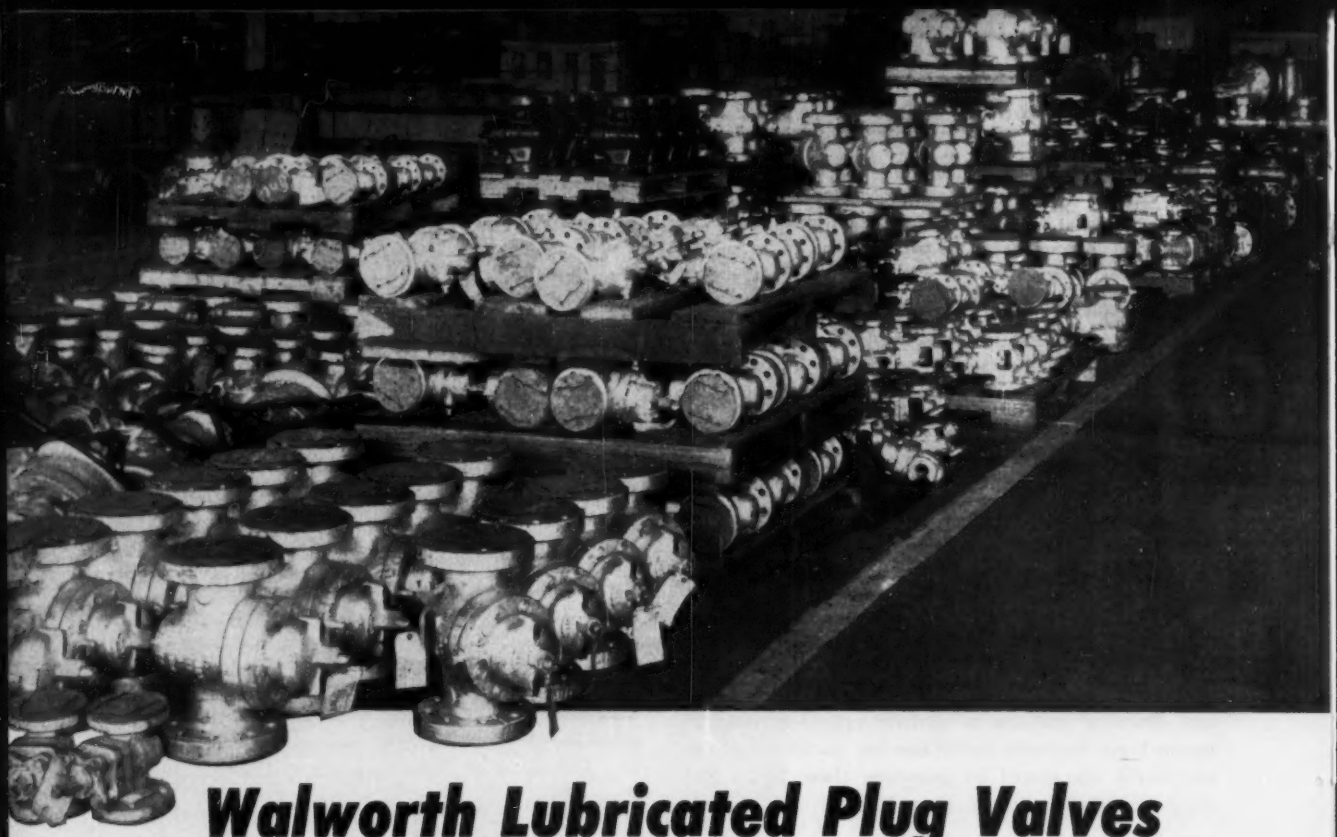
☐ **Consider Uses For Analog Computers . . .** Improved automatic control will make greater use of both digital and analog computers. Here are some individual analog applications. **Page 215.**

☐ **Treating Improves Cat Cracker Feed . . .** Here are data which will show you how much improvement in gasoline yield is achieved by acid treating the catalytic cracking charge. Turn to **Page 221.**

☐ **Cut Down Your Employe Turnover Rate . . .** Employe turnover cannot be eliminated but it can certainly be reduced from an excessive rate. Here is an article which will keep you from ever winning the White Elephant Award for the country's highest turnover rate. Make sure that you turn to **Page 245.**

☐ **So You Have to Make a Speech! . . .** Quite often those who are faced with the prospect of having to make a speech are in a dilemma because they just don't know how to put it across. Here are some suggestions that will pull you through. Turn to **Page 248.**

☐ **Operate Direct Fired Heaters Safely . . .** A fire at one of Magnolia's plants resulted in revamping shutdown procedures, routine operational procedures and employe training with respect to direct fired heaters. See **Page 252.**



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PETROLEUM REFINER and The REFINERY CATALOG for the oil, gas and petrochemical processing industry.

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PIPE LINE INDUSTRY and The PIPE LINE CATALOG for the oil and gas pipe line industry.

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Maintenance Pitch

PETROLEUM REFINER with this issue presents its Maintenance Special, the sixth such on an annual basis. We believe it's a standout in its field and feel that maintenance men will, as the ol' Thanksgiving expression goes, "gobble it up." Too, other areas are not neglected.

PR has been hammering at this maintenance theme on a regular basis for many years, and there is ample reason to label us the leader in this particular effort. And it's being generally recognized. We are including at least one maintenance article in each of our issues and maintenance people knowing that usually pick out PR first for reading. This thought was made plain to our maintenance editor, Frank Evans as he attended the Plant Maintenance Conference in Cleveland in January when scores of petroleum maintenance men commented to him on this fact.

If you know of a maintenance man who isn't acquainted with this very definite PR program, why not tell him what he's missing?

Important Reminder

EVERY NOW AND THEN some PETROLEM REFINER reader will come up with the thought that periodicals like ours should be staffed by *engineers.* And invariably they appear a bit astonished when we tell them that all of our technical editors are registered engineers. Maybe we ought to adopt the practice of some countries and like our M.D. friends do "Dr.", let "Engineer" precede each of their names. Then our masthead in the upper left would list our technical staff something like this:

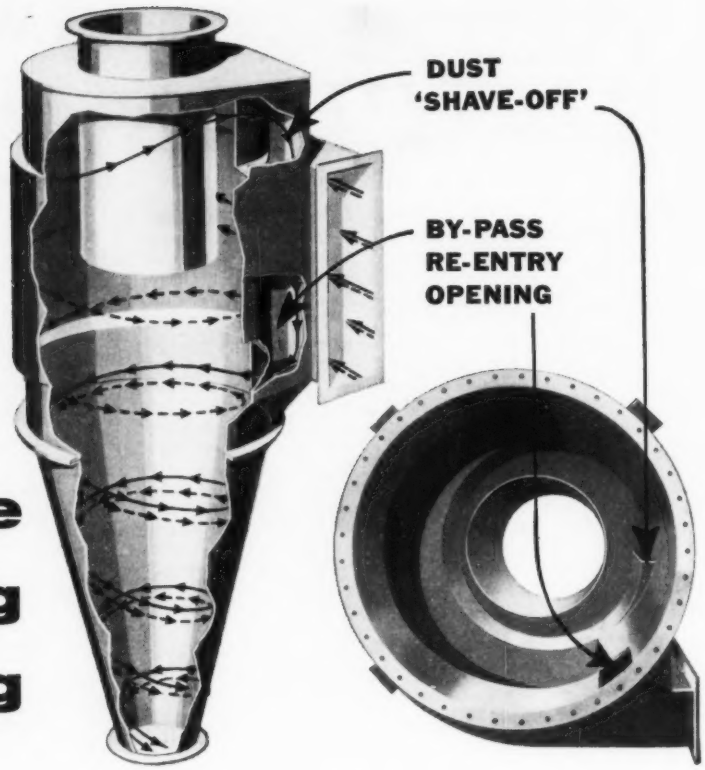
ENG. JOHN J. MCKETTA, JR.
Chairman, Editorial Committee
ENG. GEORGE B. GIBBS.....Editor
ENG. FRANK L. EVANS, JR., Maintenance and Design Editor
ENG. HAROLD L. HOFFMAN, Process and Construction Editor
ENG. THOMAS C. PONDER.....Petrochemicals Editor

The men on the staff aren't hankering particularly for this display of their professional background—that is, not nearly as anxious as Gulf Publishing Company is for readers to know that all articles appearing in our technical section have been checked by experienced, registered engineers.

Late But Not Actually

THIS HAS TO DO with the "fine print" that appears at the bottom of the first column on Page 3, immediately under the table of contents. And it is intended for those subscribers who think they should receive their copy of PETROLEUM REFINER a bit closer toward the 1st of the month—this month that is. The line is "PETROLEUM REFINER published . . . on the 12th of each month." Many monthly periodicals have a publication date around the 1st but that's not the case with PR; so subscribers are asked to take this scheduled "delayed birth" into consideration before deciding that their particular copy is late making its appearance.

This Cyclone won't clog or plug



Buell's exclusive 'Shave-off' design permits large diameter cyclones that will not clog, plug, or bridge when properly operated: you avoid unnecessary maintenance work or process interruptions.

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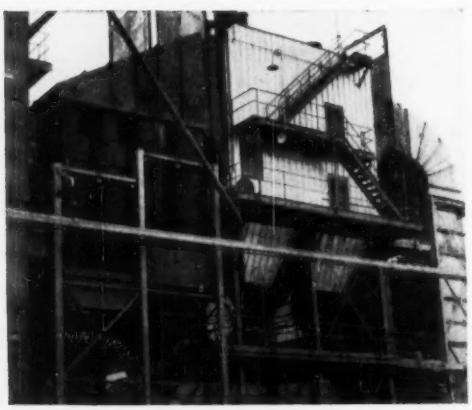

Large-diameter Buell Cyclones in series with Buell 'SF' Electric Precipitator.

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Quick Look at Industry...

What Next in the Styrene Picture? . . .

Styrene has reached stage in growth pattern where it's almost anyone's guess as to what happens now. Few realize that with mere flick of the wrist, Humble could become largest styrene producer in U.S. to tune of 400 million pounds annually. Should Gulf sing same song with 220 million pound-per-year potential, styrene market would crack wide open. On top of this, Shell now has 135-million-pound capacity, and may go into polystyrene production.

For refiners long on benzene and ethylene, styrene production is getting closer look. Rubber companies will stay out of picture unless styrene goes over 13¢ a pound. Firestone tells good story on this, since its "threat" to build 125 million pound plant few years back resulted in instantaneous 4¢ per pound price chop.

Will Steel Strike in '59? . . .

Cautious optimism is developing. Steel workers union not in good financial shape for prolonged strike. Leaders are wary of possible public condemnation for feeding inflation fire with excessive demands. Thus chances look good for peaceful, negotiated contracts with companies.

Synthetic Rubber Sales Expected to Rebound . . .

Synthetic rubber producers viewing '59 through rose-colored lenses. Expect to bounce back with 12% hike in sales this year—despite expected export drop. U.S. producers figure to sell only 150,000 tons overseas—down 28% from '58. England and East Germany account for most of decrease. Reason: two new plants with combined annual capacity of 140,000 tons. Sidelight: U.S. plants only ran at 67% capacity last year.

California Switches Smog Blame . . .

California Governor Brown asking for power to compel, if necessary, use of antipollutant devices on autos. Feasible or not, it recognizes true cause of smog problem—quite a contrast to former Governor Knight's condemnation of oil industry for allowing refiners to pollute Los Angeles air.

Brown's request could be due to 30-month study involving 18 L.A. area refineries. Final report says $33 million spent for control by refiners in last 10 years paid off. Refiners now account for only 8% of worst offender—nitrogen. Motor vehicle exhausts contribute 70%.

Latest Octane Postings . . .

Average February rating for premium gasoline unchanged from January's 99.0 F-1 mark according to latest Ethyl survey. Regular increased slightly by slipping up to 91.6 F-1 after toeing line at 91.5 for three months.

Petrochemicals Eye Supply Lines . . .

Petrochemicals, hard hit by recent Gulf Oil strike, may take closer look at ethylene pipe line tie-ins. Ethylene purchasers and seller-makers need assurance of continued ethylene deliveries in event of strike or other supply interruption. Aromatics shouldn't suffer—other refiners have ample capacity to meet needs of any cut-off customers.

Corporations Eye Economic Trends . . .

In recent survey of nation's 309 top firms, Socony-Mobil found 30% have one or more economists on staff—another 50% use outside economic counsel. In 1950, similar survey by National Industrial Conference Board indicated only 10% used full-time economists.

Reason for more reliance on economists is summed up by one respondent to Socony: "Because of the accuracy of predictions during the past 5 years, management can now place more reliance on the judgment of its economists . . ."

Craft Lines Slowly Fading? . . .

Competition and lower profits forcing plants to streamline work forces. Trend is to stronger more persistent management efforts for unions to let workers cross craft lines. Resulting multicraft labor would be particularly effective in trimming labor fat from small maintenance jobs.

Quick Look at World Oil Taxes . . .

Petroleum really pays its way! Here's a globe-hopping rundown on percentage of gasoline prices going into taxes and duties: Paris 79%; Italy 71%; Brussels, Belgium 69%; The Hague, Netherlands 61%; Luxemburg 56%; Hamburg, Germany 54%; United States 30%.

Oil A-Blasts—Pro and Con . . .

From recent meet of Richfield Oil and Alberta government officials comes indication of nuclear explosions to release oil from Athabasca tar sands. Group will blast experimentally next winter—if results warrant, more blasts will follow.

Rep. Daniel J. Flood threw cold water on fire to use same technique to free oil from shale. Called it "scientific hoax of the century." Said, "boys at AEC are playing with pretty expensive firecrackers when the chairman (John McCone) admits it will cost at least $3 million and probably will not produce any oil."

Despite this, Interior Secretary Seaton sent letters to private industry to determine interest in Green River blast. Under present plans, government will foot half the bill if industry picks up tab for other 50%.

Quick Look Around the World . . .

Shell Oil hikes mandatory retirement age from 60 to 65 . . . McColl-Frontenac Oil changes name to Texaco Canada, Ltd. . . . Signal Oil & Gas (recently merged with Hancock Oil) preparing another merger—this time with Bankline Oil . . . Esso R&E organizes new unit of scientists to do advanced research on super rocket fuels . . . It's a good bet we will not see hike in federal gasoline tax this year (see page 13).

Red Oil Creates Quite a Stir . . .

Commerce Oil's deal to import 112,000 barrels of Iron Curtain (Rumanian) oil touched off chain reaction of criticism. Two Senators wired objections to President Eisenhower—others stepped-up demands for mandatory controls. One contention: this is only "entering wedge" of communist drive to enter American fuel markets.

Teamsters Bid for Bayway Union . . .

Teamster boss Jimmy Hoffa nuzzles closer to refiners with his "educational talk" to 400 members of Esso's Bayway plant. Meeting was closed, but amounted to offer for International Petroleum Workers Union to affiliate with Teamsters. IPWU source indicates Hoffa's appearance "was impressive."

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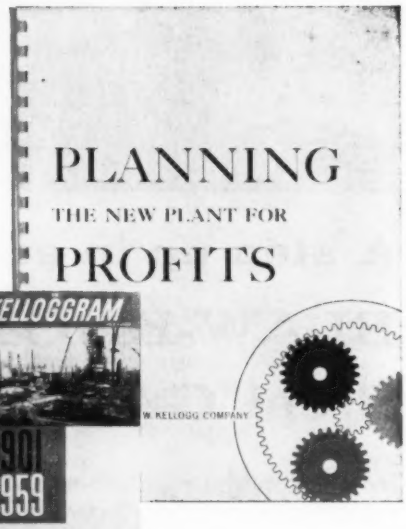
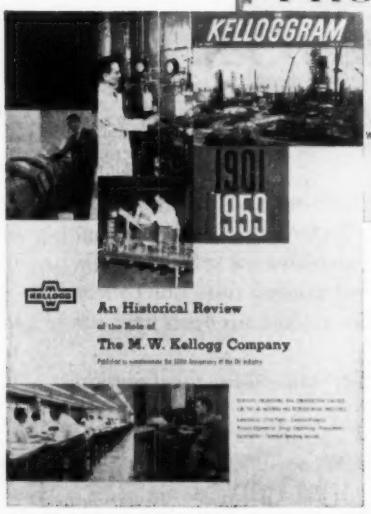
For More Efficient Capital Investments

For oil companies facing up to increasing operating costs and product competition, this year's oil centennial will be a time for seriously studying the estimated capital expenditures and refining economics of the immediate and long-term future, as well as reviewing the accomplishments and methods of the past.

To assist management in making the soundest investment decisions—in terms of plant engineering, procurement and construction, Kellogg has prepared two booklets. One of these reviews this world-wide organization's role in the petroleum and petrochemical industries since 1901.
The other is a comprehensive description of the company's unique economic approach to building the new plant, and fully documents its ability to undertake all or part of the responsibility.

Oil and chemical company executives charged with making capital expenditures will find these booklets profitable reading—particularly the explanation of Kellogg's method of coordinating and controlling the engineering, procurement, and construction of new plants. Copies can be obtained promptly by returning the coupon.





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No More Miles of "Ghost" Roads, Please!

PETROLEUM REFINER does not share the enthusiasm for additional taxes on gasoline, an idea that seems to lead the parade when state or federal governments are looking around for new sources of income.

So it is with a feeling of relief that we noted a statement by the chairman of the tax-writing Ways and Means Committee of the House of Representatives that virtually assures the elimination of that feature from Washington's tax measures.

There was little rhyme and no reason for consideration of an additional gasoline tax in the first place.

Today, federal, state and local taxes on gasoline hit a national average of about 9 cents per gallon. This is equal to 40 percent of the service station price of regular grade gasoline, exclusive of the tax. No other item essential to daily living is so highly taxed, yet the President proposed to increase the federal portion of this load by another 50 percent.

"Ghost" Roads. The excuse for his proposal, one form of expediency rather than justice, is "to make highway related taxes support our vast highway expenditures." Not only is this erroneous, but also it is actually misleading. Highway users are not only paying all federal highway expenditures, but are in addition, contributing millions—even billions of dollars for "ghost" roads. These "ghost" roads are a phenomenon of just the past quarter-century. They are the roads that highway users paid for in gasoline taxes and motor vehicle fees, but never received because the money was diverted to non-highway functions of government.

Last year, for example, tax collections by the federal government totaled $3.6 billion. Of this amount, however, only $2.1 billion found its way into the highway fund. The remaining $1.5 billion—42 percent of the amount collected—was paid into the Treasury's general fund for other federal activities which have absolutely no relation to highways.

Unfortunately, however, it's not only the federal government which is guilty of dipping into this lucrative and available revenue-pot. Most states have been equally as generous in providing "ghost" roads for travelers. As a matter of fact, during the 23 years ending with 1957, more than $4.7 billion of highway-user tax money collected by the states from American motorists found its way into virtually every kind of government activity except roads.

Based on the average costs of highways in this period, this means that approximately 148,000 miles of improved roads which could have been built by states have been lost. These 148,000 miles are part of our "ghost" roads.

Against the Law. And another interesting point: the federal highway law condemns this practice of diverting highway-user tax revenues from highway improvement. The law provides penalties, under certain circumstances, in reduced federal highway grants for states which engage in this practice on the grounds that, "It is unfair and unjust to tax motor vehicle transportation unless the proceeds of such taxation are applied to the construction, improvement or maintenance of highways." That's the way the law reads, but the federal government is now the nation's number one offender in this very practice which it condemns.

It is easy to see, therefore, that the anticipated "deficit" in the federal highway trust fund in 1960 and 1961 is nothing more than "fiscal fiction." If all the automotive taxes had been used for highways—or if all is used for highways in 1960 and 1961—there would be no highway fund deficit, and therefore no need for such an unsound suggestion as another gasoline tax hike.

Now, what can we—we who would bear the brunt of any additional tax burden—do about the situation? For one thing, we can write our congressmen commending the promised elimination and also expressing our extreme disapproval of even contemplating an increased gasoline tax while such conditions exist.

The American people could very well go on record right now as unalterably opposed to upping the gasoline tax in face of the rather shameful fact that all of the money collected now does not go into highway construction.

We should tell them, "Look in the other direction—fight to reduce gasoline taxes rather than raise them." After all, our solons will hardly argue over the fact that gasoline is certainly out of the luxury class and now is a necessity. Yet in spite of this, gasoline still has the dubious distinction of ranking with whiskey and cigarets as the three highest-taxed commodities in America. Cigarets and whiskey bear such a high rate because they are considered luxuries

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which most people can do without. But gasoline . . . well, even if you exclude many of the necessary uses, you can't alter the fact that 68 percent of the working people need their cars to get to their jobs!

Enact State Laws. Another thing you can do right at home is to ask your state legislators to do their utmost in restricting gasoline taxes. The people of Ohio did it with the result that a statewide referendum approved an amendment to the constitution providing that gasoline taxes collected for highway improvements must be used solely for that purpose.

Gasoline taxes are already a heavy burden on each and every family in the nation. Someone mentioned that here is a good place for the federal government to start thinking about that old law of diminishing returns, because another tax hike just might change the motoring habits of a great many people. If that would be the case, then all of our "ghost" roads could at last be put to good use—carrying the "ghost" cars of millions of Americans who don't drive much anymore because gasoline's too high!

"Wolf" Cry Too Frequent

IT IS interesting to note that for the first time in the past seven years, the number of American college students entering schools decreased. The 153 accredited American engineering colleges have 2.9 percent less students starting the Fall 1958 term than started the Fall 1957 semester. On top of this, the freshman class of 59,164 which entered last Fall was 11.6 percent smaller than the 67,071 in 1957.

Of course, declining enrollments have not yet affected the number of engineering graduates as there were 31,216 in the 1957-58 period as compared with 27,748 the previous year. However, we should not overlook the fact that these numbers are far short of the record graduation of eight years ago when World War II veterans were finishing their delayed college careers.

These engineering enrollment figures, come from the annual Official Survey of Students and Degrees conducted by the American Society for Engineering Education in cooperation with the U. S. Office of Education.

Looking at the over-all college scene, engineering students comprise about 7 percent of American college students as compared with nearly 8.5 percent in 1957. On top of this, enrollment of second-year students is down 6 percent from 1957, and third year students down 4 percent. Only in the fourth and fifth year category is this year's enrollment total as large as 1957.

The situation looks a little brighter in the graduate field, as study on this level continues to increase sharply with enrollment at record levels. This fall, 27,456 students were enrolled in MS degree programs—an increase of 14.7 percent over 1957. Those studying for PhD degrees totaled 4,762—a hike of 14.3 percent.

These figures cover the 153 American colleges with one of more of their engineering curricula accredited by Engineers Council for Professional Development. In 70 other schools which were not included, there were 39,047 undergraduate engineering students enrolled this fall and 4,116 degrees awarded in 1957-58.

Viewing this over-all situation, the important point to ask is "Why?" Why is it that fewer students want to devote their life to engineering?

Perhaps the answer lies partly in the fact that within barely little more than a year's time, our synthetic engineering "shortage" suddenly turned into a surplus. Yet in spite of this, some are again shouting that there's another engineering "shortage" likely.

Even last June PETROLEUM REFINER urged, "Let's don't create a situation where every young man and woman is leary of entering into a scientific education. One of these days we may really have to cry 'wolf'—then who will answer?"

Why Economic Suicide?

IF YOU were manufacturing a product, would you give your technical know-how to another person, even though you knew this person was going to use this newly-gained knowledge to put you out of business? Of course you wouldn't—ridiculous!

By the same token, it seems just as ridiculous to sell or trade American production know-how and plants to Soviet Russia. The Reds have never tried to hide the fact that some day they hope to conquer this country in some form or another—be it technologically, economically or militarily.

The Manufacturing Chemists Association has been doing a good job of selling these points and has informed state and commerce departments that the chemical industry opposes selling U.S. chemical skill to Russia. It has also recommended that our government not relax its policies with respect to such trade with Russia and also that it should get other Western nations to follow a like policy.

Of course, this deals only with technical know-how, and not trade in commodities or finished products. "Russia has devoted most of its technical talents to preparing for military purposes," said General John E. Hull, MCA President, "and therefore, has lagged behind the U.S. in developing commercial and consumer production. She probably has the ability to catch up in time in these lines if she so wishes, but we see no advantage, and possible disadvantage, in giving away America's technical time lead."

"One advantage to us has already been pointed out by Khrushchev," General Hull added. "Russia intends to compete as strongly as possible with America for world markets. Since, for political purposes, she can peg her prices almost at will, and, regardless of cost of production, she apparently seeks American production know-how with the intent to undercut and destroy U.S. world trade in the very products she asks us to teach her to make. In some fields Russia has already demonstrated the ability to do this."

This seems to be not only a prudent but a quite necessary stand for this country to take. After all, the Russians are spending an awful lot of time and effort to deal us a death blow—why should we help them along by committing economic suicide?

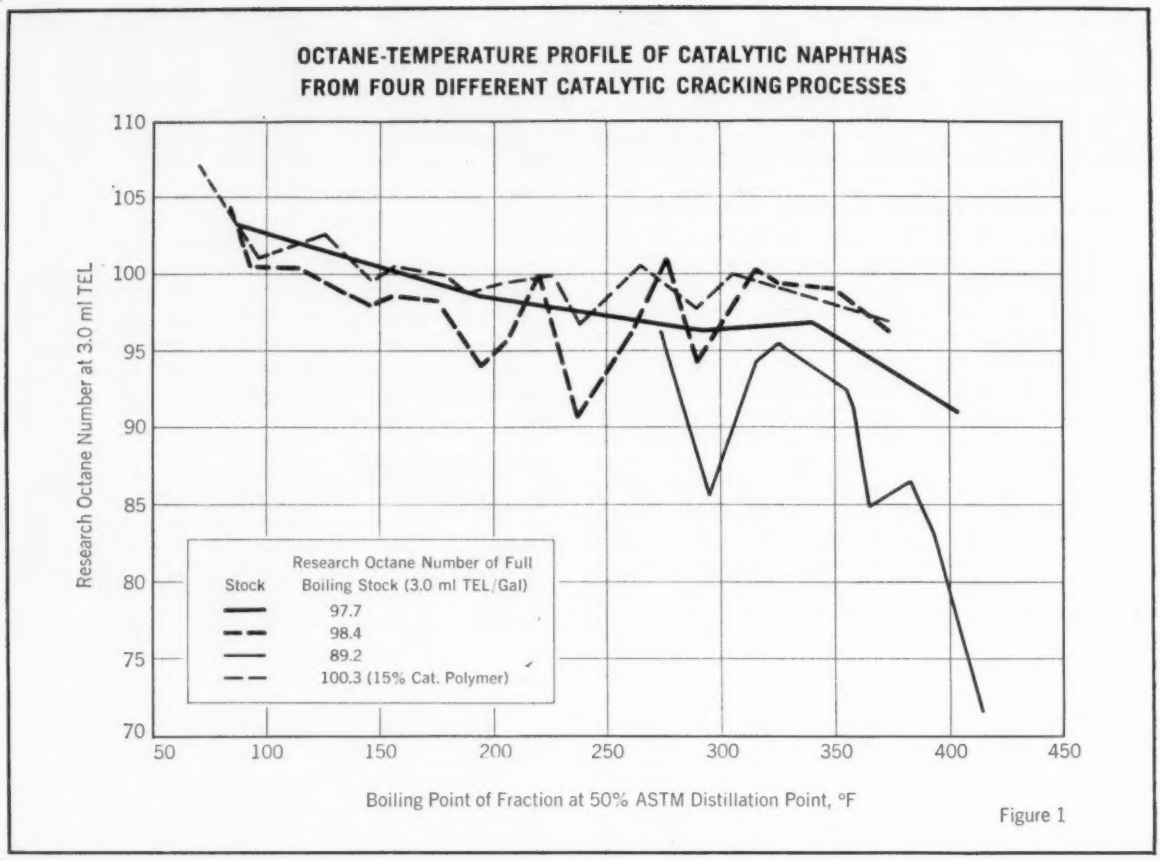

Figure 1

Octane profiles show how to use high-octane gasoline components more effectively

By D. D. Hornbeck, Refinery Technologist

IN RECENT YEARS, refiners have shown interest in separating high (and low) octane hydrocarbons of gasoline blend stocks. Fractional analysis has been used to separate, for distribution studies, such stocks as cracked gasoline, reformed gasoline, reformer charge stock and, in some cases, finished gasoline.

A report of several "octane profile" studies conducted in Ethyl's Detroit Laboratories is now available.

How "Octane Profiles" Are Drawn

A sample is carefully fractionated into narrow cuts of 5 to 10 percent of the total fuel. Laboratory octanes, and other pertinent data such as hydrocarbon type are obtained on each fraction. A plot of the distribution of antiknock quality throughout the boiling range of the gasoline is then drawn. This plot is referred to as an "octane profile."

Fractional Analysis For Octane Improvement Studies

In a refinery where tetraethyllead is near the allowable maximum, splitting an existing process stream and blending the higher octane fraction to a given gasoline grade may be an effective approach to octane improvement.

This technique doesn't increase the antiknock quality of the gasoline pool. But frequently it permits the refiner to meet higher octane specifications for a given grade of gasoline.

And higher octanes generally are possible with lower investment and operating costs than by other process methods.

The "octane profiles" of four catalytically cracked gasolines from different refining processes are compared in Figure 1. It will be noted that distribution of high and low-octane hydrocarbons throughout the boiling range of the stock follows a general pattern.

Each stream can be split to yield a portion that is higher in antiknock quality than the full-boiling material. This is true of almost all cracked gasolines even though large differences in octane quality exist at various points in the boiling range.

With the cracked gasolines shown, 30 to 50 percent of the light fraction is from 2 to 4 Research octane numbers higher than the full-boiling material.

Figure 2 compares "octane profiles" of four gasolines from different catalytic reforming processes. In this case the heavy fractions will yield a 20 to 40 percent cut that is 2 to 6 RON higher than the full-boiling material.

Fractional Analysis For Examination of Charge Stock

Figure 3 shows "octane profiles" of two

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catalytic-reformer charge stocks. The straight run naphtha contains a front-end cut that is already satisfactory blending stock for regular gasoline. Further, the hydrocarbon-type composition showed no naphthenes in this fraction and, therefore, its value as part of reformer feed is questionable.

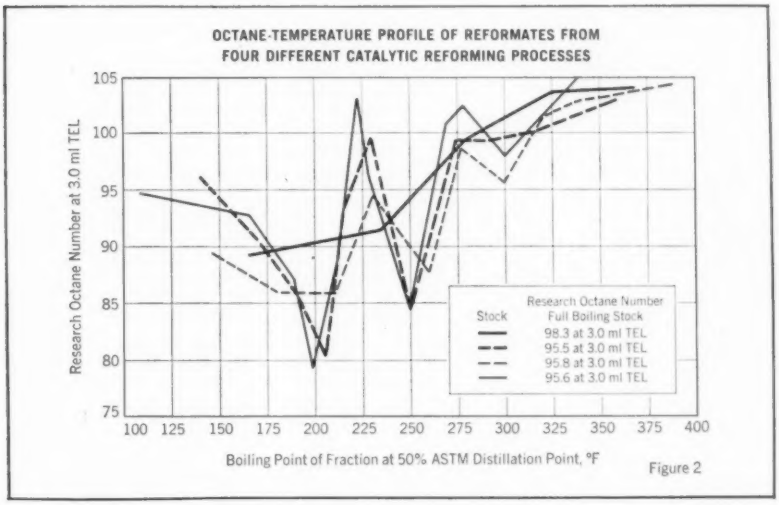
Similarly, the pressure distillate shown in the same figure contains high-octane light olefins according to hydrocarbon-type analysis and "octane profile." This cut could very well be blended directly to motor fuel since, as part of the reformer charge stock, the high-octane olefins would be saturated.

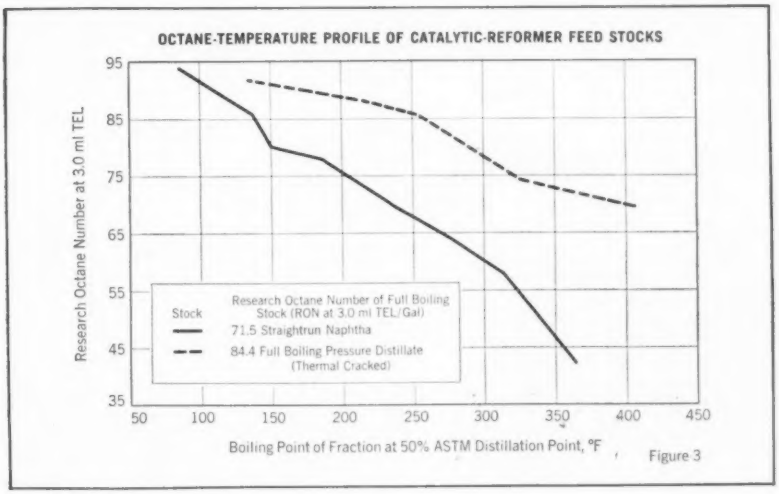
Finding the Cause of Knocking Problems

"Octane profiles" help in understanding some low-speed knocking problems. In engines where the vapor and liquid portions of a fuel are unevenly distributed to the cylinders, TEL may tend to concentrate in the heavier fraction.

Maldistribution usually is most pronounced in the first seconds of wide open throttle accelerations. The problem is aggravated with fuels of low tetraethyllead levels since lighter components may be practically free of antiknock agent upon entering a cylinder during the first moments of acceleration.

With fuels having low-octane front-end components, low-speed road-knock may occur since the front-end octane level may be 5 to 10 numbers below the octane of the whole fuel. The portion of the fuel causing this difficulty can be isolated by fractional analysis. These problems may be solved by replacing the low-boiling, low-octane fraction with higher quality material.


OCTANE-TEMPERATURE PROFILE OF REFORMATES FROM FOUR DIFFERENT CATALYTIC REFORMING PROCESSES
Research Octane Number at 3.0 ml TEL
105
100
95
90
85
80
75
100 125 150 175 200 225 250 275 300 325 350 375 400
Boiling Point of Fraction at 50% ASTM Distillation Point, °F
Stock
Research Octane Number Full Boiling Stock
98.3 at 3.0 ml TEL
95.5 at 3.0 ml TEL
95.8 at 3.0 ml TEL
95.6 at 3.0 ml TEL
Figure 2


OCTANE-TEMPERATURE PROFILE OF CATALYTIC-REFORMER FEED STOCKS
Research Octane Number at 3.0 ml TEL
95
85
75
65
55
45
35
50 100 150 200 250 300 350 400 450
Boiling Point of Fraction at 50% ASTM Distillation Point, °F
Stock
Research Octane Number of Full Boiling Stock (RON at 3.0 ml TEL/Gal)
71.5 Straightrun Naphtha
84.4 Full Boiling Pressure Distillate (Thermal Cracked)
Figure 3

How Ethyl Research is helping you

Ethyl Research is continually utilizing its extensive laboratory fractionating facilities to help refiners in these ways:

1. To develop quality distribution data for octane improvement studies.
2. To evaluate charge stocks.
3. To understand unusual fuel knock problems.

Results of several of these studies can be found in Ethyl's report, "Fractional Analysis of Some Refinery Process Streams."

Copies of the report are available from your Ethyl Representative, or by writing to Ethyl Corporation, 100 Park Avenue, New York 17, New York.

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FISH OIL
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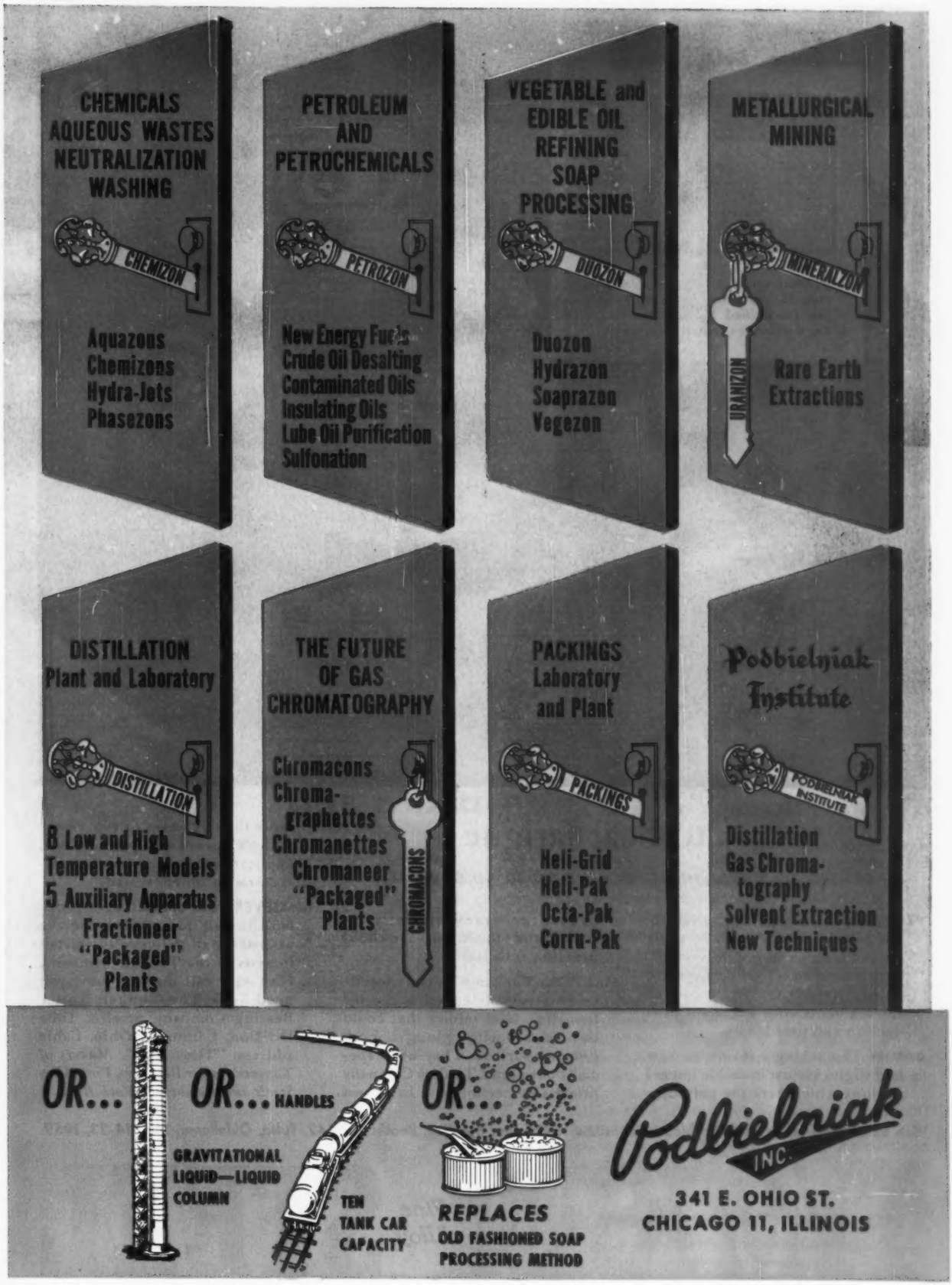
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Fractioneer
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Chroma-
graphettes
Chromanettes
Chromaneer
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Plants
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PACKINGS
Heli-Grid
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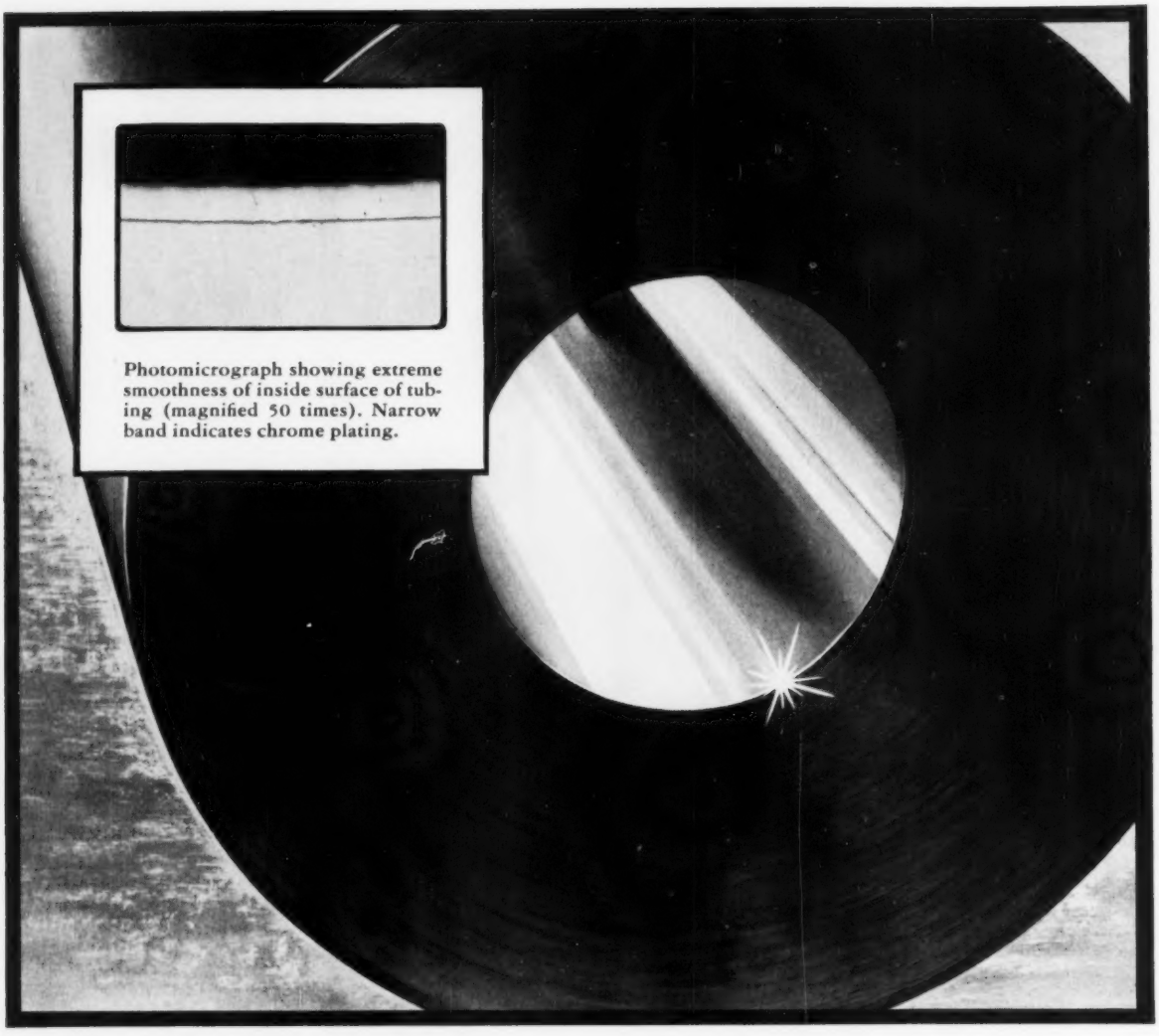

Photomicrograph showing extreme smoothness of inside surface of tubing (magnified 50 times). Narrow band indicates chrome plating.

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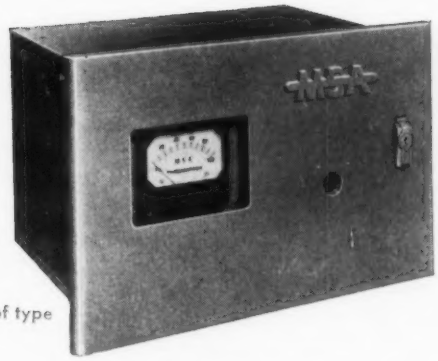
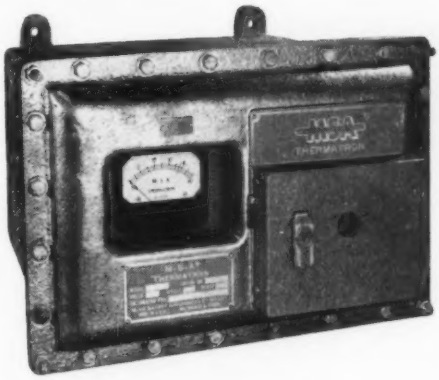


Non-explosion-proof type



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M-S-A Gas Thermatron with recorder mounted in cubicle

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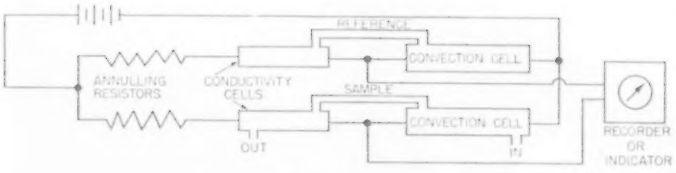

Schematic Flow and Wiring Diagram

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How Much Steam Should a Steam Trap Trap?

. . . some answers to commonly asked questions about the primary job of a steam trap

You don't need a doctor's degree in thermodynamics to answer the question at the top of this page. Naturally, a steam trap should trap *all* the steam.

Unfortunately for you, the problem isn't quite that simple. After all, a shut off valve would trap all the steam . . . and condensate, and air, and carbon dioxide as well.

So we'd better amend the answer to the question this way: A steam trap should trap *all* the steam but *must* remove condensate, air and carbon dioxide as rapidly as they accumulate.

With this established, let's take a closer look at what's involved:

A Steam Trap Should Trap All The Steam

If you've had experience with several different makes of traps, you already know that some trap steam better than others. The operating principle of the trap is what makes the difference. We like to talk about it because Armstrong traps are designed so that no steam can get to the orifice. The valve is always water sealed. Result: *More efficient steam utilization, lower fuel costs.*

A Steam Trap Should Remove Condensate

All traps remove condensate—after a fashion. For maximum efficiency in the unit being drained, though, the trick is to get it out without waiting for it to cool and without leaking steam.

Armstrong's water sealed valve takes care of steam leakage. The inverted bucket operating principle opens the trap for water regardless of its temperature. This means you get the condensate out as quickly as it accumulates. Result: *Higher temperatures and better heat transfer in steam heated units.*

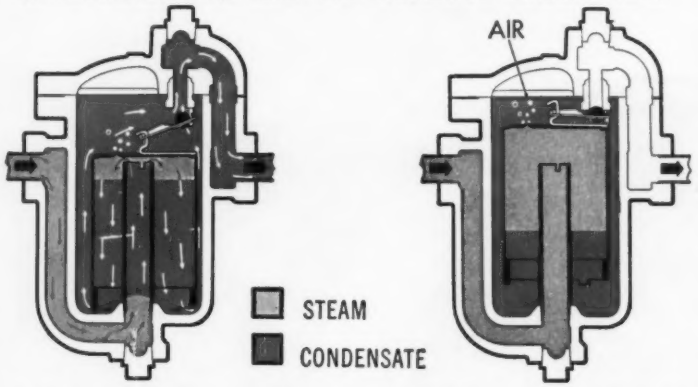
A Steam Trap Should Remove Air and CO_2

Part and parcel of the condensate removal problem is removal of air as well as oxygen and carbon dioxide—two real troublemakers. Air tends to reduce operating temperatures and interfere with heat transfer. CO_2 goes into solution to form corrosive carbonic acid which, for example, can eat unit heater tubes. O_2 aggravates the situation. Believe it or not, but all traps don't properly remove air and CO_2.

By now, you've probably guessed that Armstrong traps *do* remove air and CO_2. Armstrong design (see illustration) provides continuous venting of air and CO_2. By opening suddenly, the Armstrong trap creates a momentary pressure drop to "pump" the air down to be vented. Result: *Higher temperatures, faster heat-up, better heat transfer and reduced corrosion.*

Note: When required, specially sized air vents are furnished. For fast heat-up of low pressure on-and-off units, Armstrong provides open float and thermostatic air vent traps.

HERE'S THE STEAM TRAP DESIGN THAT GETS RID OF CONDENSATE AND AIR WITHOUT STEAM LOSS



Trap open. Condensate entering trap has caused bucket to lose buoyancy. Weight of bucket times leverage pulls valve open. Air is discharged along with condensate.

Trap closed. Steam has floated inverted bucket; valve is held tightly closed by system pressure. Air entering trap passes through bucket vent and accumulates at top of trap.

What's the Final Answer?

Summing it all up, you'll get the best service from steam heated units that are equipped with traps designed to trap *all* the steam and remove air and condensate as quickly as it accumulates. In our prejudiced viewpoint, this means Armstrong traps. More important are the several thousand users of Armstrong traps who have proved the point.

Before you make up your mind, though, consider the minimum maintenance requirements of Armstrong traps . . . and the convenient assistance your local Armstrong Representative provides. These are important plus values.

Put Up or Shut Up

We're so confident that we "put up". Armstrong traps are unconditionally guaranteed to satisfy. So you can find out for yourself with practically no risk. If you're not completely satisfied with the way they do their job, you can get your money back.

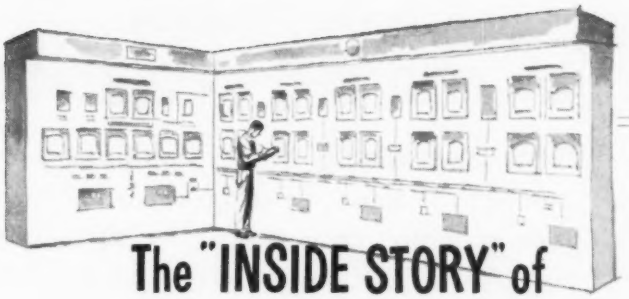
* * *

The 44-page Armstrong Steam Trap book goes into greater detail on these and other Armstrong features. It also discusses trap selection, installation and maintenance. Ask your Armstrong Representative for a copy or write

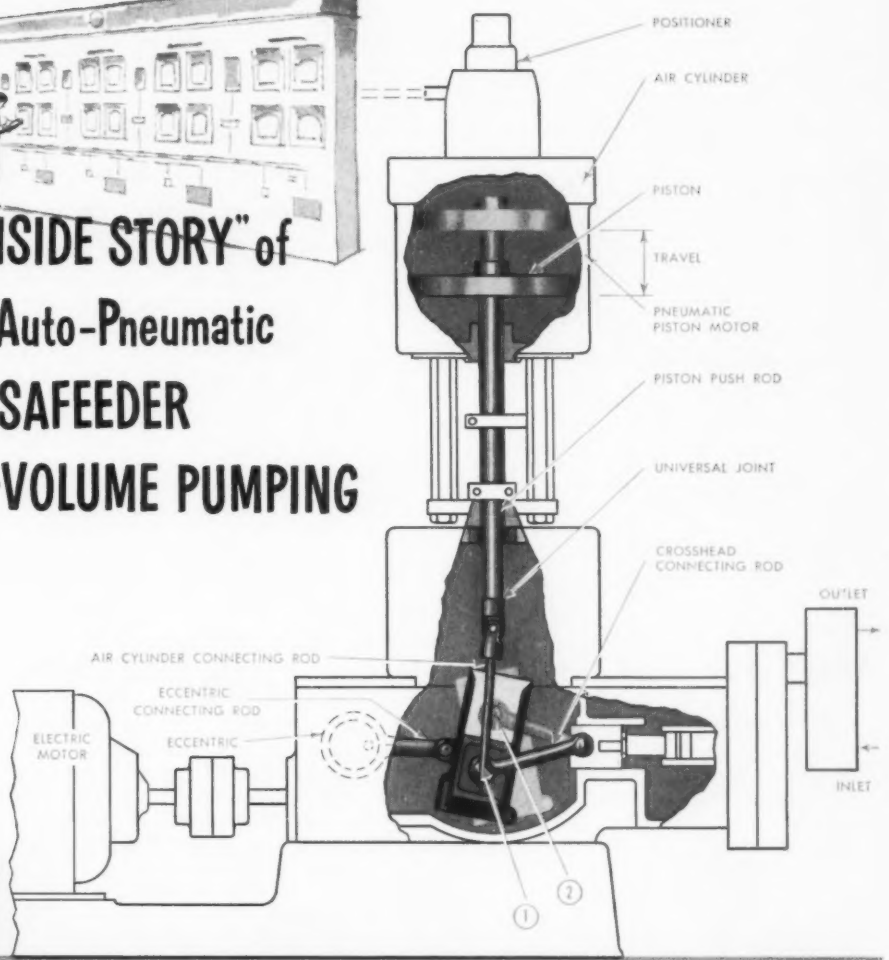
Armstrong Machine Works
8522 Maple Street
Three Rivers, Michigan

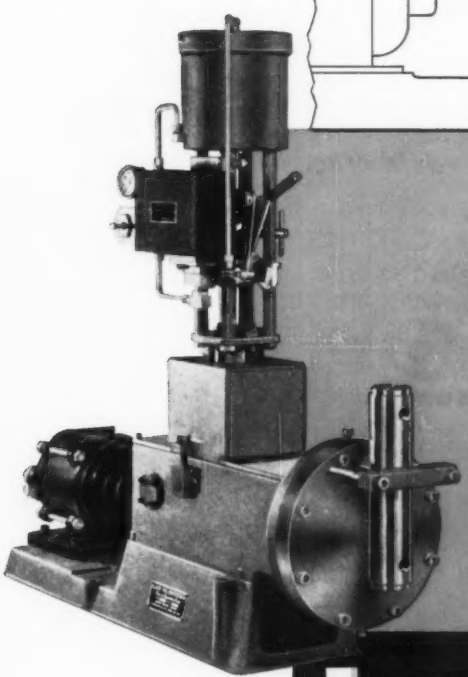
ARMSTRONG STEAM TRAPS

For more data on advertised products, use Readers' Service Cards, last page.



The "INSIDE STORY" of Auto-Pneumatic PULSAFEEDER CONTROLLED-VOLUME PUMPING





In many industrial processes, liquids must be metered in relation to some changing process condition. It can be a change in flow or pH, temperature or pressure. Instruments can sense such a change and transmit an air signal descriptive of that change. The auto-pneumatic control mounted on the Pulsafeeder pump receives and interprets this signal and automatically adjusts pump to meet the process variable. This is accomplished by a positioning device on the auto-pneumatic control that loads or unloads the air cylinder, accurately moving the air piston to position the connecting rod (1) in relation to the axis (2). This determines the stroke length of the pump—a longer stroke increases pump output; a shorter stroke reduces output. Instrument air pressure over a range of 3-15 psig. controls Pulsafeeder output from 0-100% of capacity. Ratio adjustment is available in all models.

WRITE FOR BULLETIN 440 *with typical applications, flow charts, description and specifications of both* MANUALLY CONTROLLED *and* AUTO-PNEUMATIC *models of various capacities and constructions. Inquiry Data Sheet included from which we can make specific engineering recommendation for your processing requirement. Write Lapp Insulator Co., Inc., Process Equipment Div., 3406 Poplar St., Le Roy, N. Y.*

Lapp

For more data on advertised products, use Readers' Service Cards, last page.

ROYAL PRECISION

LGP-30

Twice the capacity of any computer in its class... easiest to program in basic machine language... lowest in cost

With the compact, powerful LGP-30, you can obtain peak operating efficiency through on-site linear programming... can save substantially on every barrel produced by faster, simpler selection of (1) optimum-level production, sale and purchase of gasoline, butane, naphtha etc.; (2) severity level of the catalytic reformer; (3) tetraethyl lead content.

Because the LGP-30 is mobile, you can now have high-speed electronic computation *wherever you need it.* Operating from any convenient wall outlet, the self-cooled LGP-30 gives you memory (4096 words) and capacity comparable to computers many times its size and cost.

The lowest-priced complete computer you can buy, the LGP-30 has been so simplified that even non-technical personnel quickly grasp its operation. A library of sub-routines and programs is maintained – as well as an active users organization. Service facilities are available coast-to-coast.

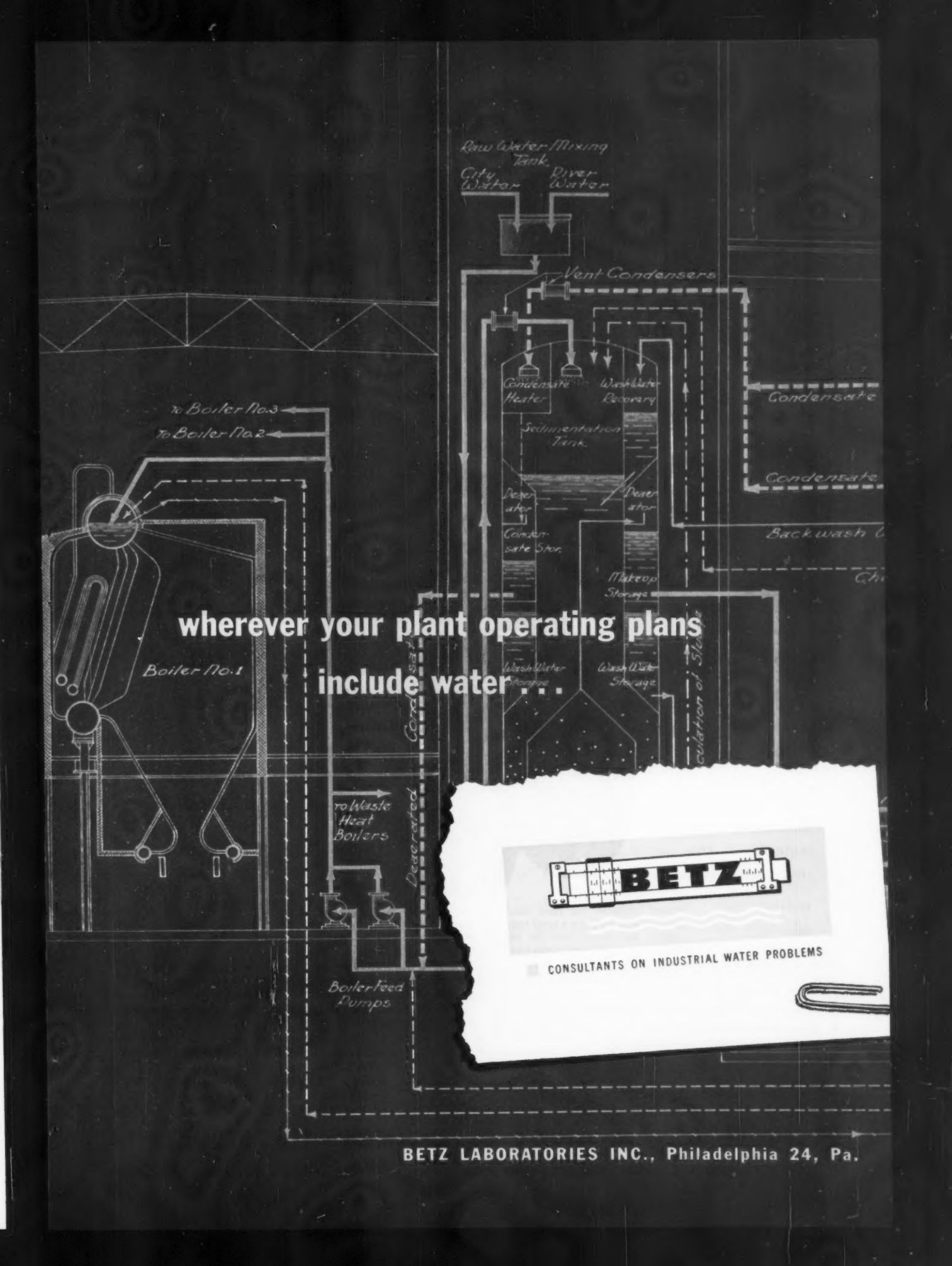
Gives you optimum level efficiency in production, sales, purchase!

Other important jobs now being assigned to the LGP-30 in numerous petroleum installations include the following: pipeline problems; mass spectrometer calculations; analysis of oil field production; flash point calculations; pumping and batching scheduling; correlation of seismic records; reservoir engineering studies; well-logging interpretations.

ROYAL McBEE

data processing division

For further information and specifications, write Royal McBee Corporation, Data Processing Division, Port Chester, N.Y.



wherever your plant operating plans include water . . .

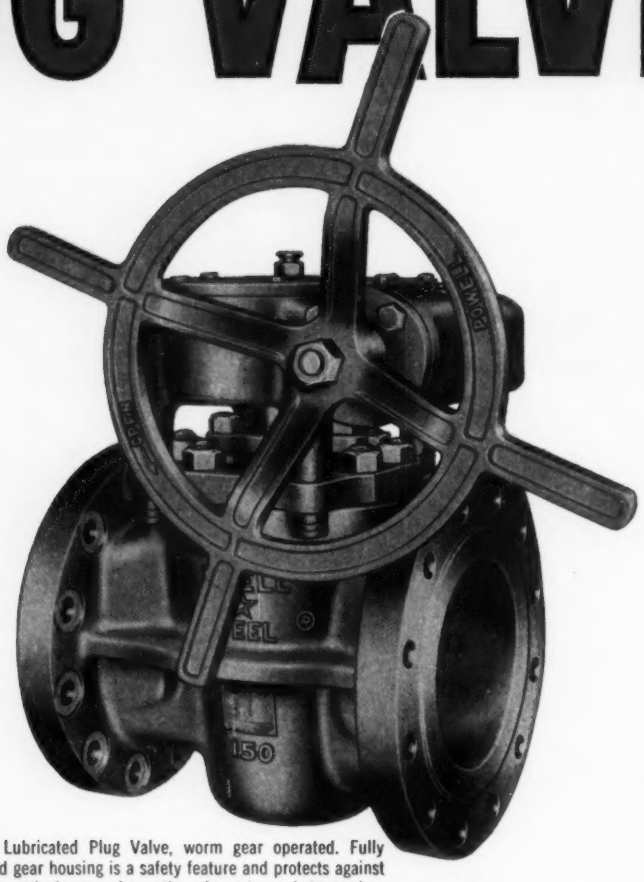
BETZ

CONSULTANTS ON INDUSTRIAL WATER PROBLEMS

BETZ LABORATORIES INC., Philadelphia 24, Pa.

POWELL

LUBRICATED PLUG VALVES



Powell Lubricated Plug Valve, worm gear operated. Fully enclosed gear housing is a safety feature and protects against injuries and damage from the elements and tampering.

Like all Powell Valves, Powell Lubricated Plug Valves are superior in their field . . . and have many advantages over conventional types of Valves:

- Simple design: Only three basic parts—Body, Bonnet, Plug.
- Quick, complete shut-off.
- Tapered plug assures positive seating.
- Machined surfaces of plug and body are not exposed in open position.
- Cavity-free straight passage assures streamlined flow.

Powell Lubricated Plug Valves are available in sizes ½" through 16", depending on the type required—Semi-steel 175 and 200 pounds WOG; Carbon Steel ASA 150 and 300 pounds.

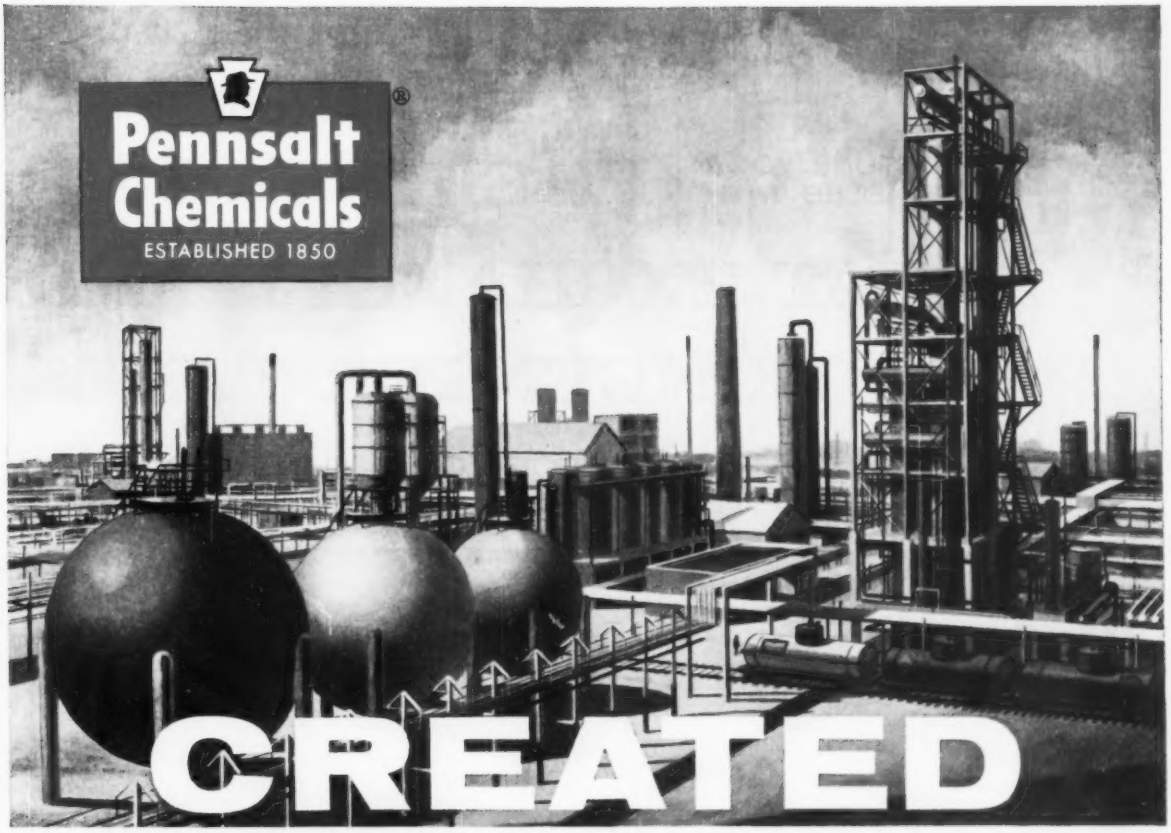
Powell can also furnish Lubricated Plug Valves in other alloys on special order.

For all your valve needs, consult your local Powell Distributor—or write directly to us. Send for our new Lubricated Plug Valve Catalog, Number PV-5.

The Wm. Powell Company • Cincinnati 22, Ohio

Dependable Valves Since 1846

POWELL...world's largest family of valves



in only 8 months at 10 per cent under budget

10% UNDER BUDGET—Pennsalt Chemicals Corporation's new Methylamines plant was completed by Catalytic, Engineers—Constructors, at a figure ten per cent under the original estimated cost.

AHEAD OF SCHEDULE—The Methylamines plant was completed and ready for start-up in only eight months after the start of engineering. This "On-Time" completion was in advance of the requirements of Pennsalt Chemicals Corporation.

UNDIVIDED RESPONSIBILITY—Catalytic's control and coordination of all phases of this project and close cooperation with the client were prime factors in the successful completion. This Methylamines plant again proved Catalytic's ability to render all client services "On-Time, On-Budget".

CATALYTIC
CONSTRUCTION COMPANY

Philadelphia 2, Pa.
New York, N. Y.
Baton Rouge, La.
Toledo, O.
Tulsa, Okla.
In Canada: Catalytic Construction of Canada, Limited; Sarnia, Ontario; Toronto, Ontario; Montreal, Quebec.

Catalytic *On-Time . . . On-Budget* Services for the metallurgical, chemical, petrochemical and oil refining industries: Project Analysis; Process Development; Process Design; Economic Studies; Engineering; Procurement; Construction.

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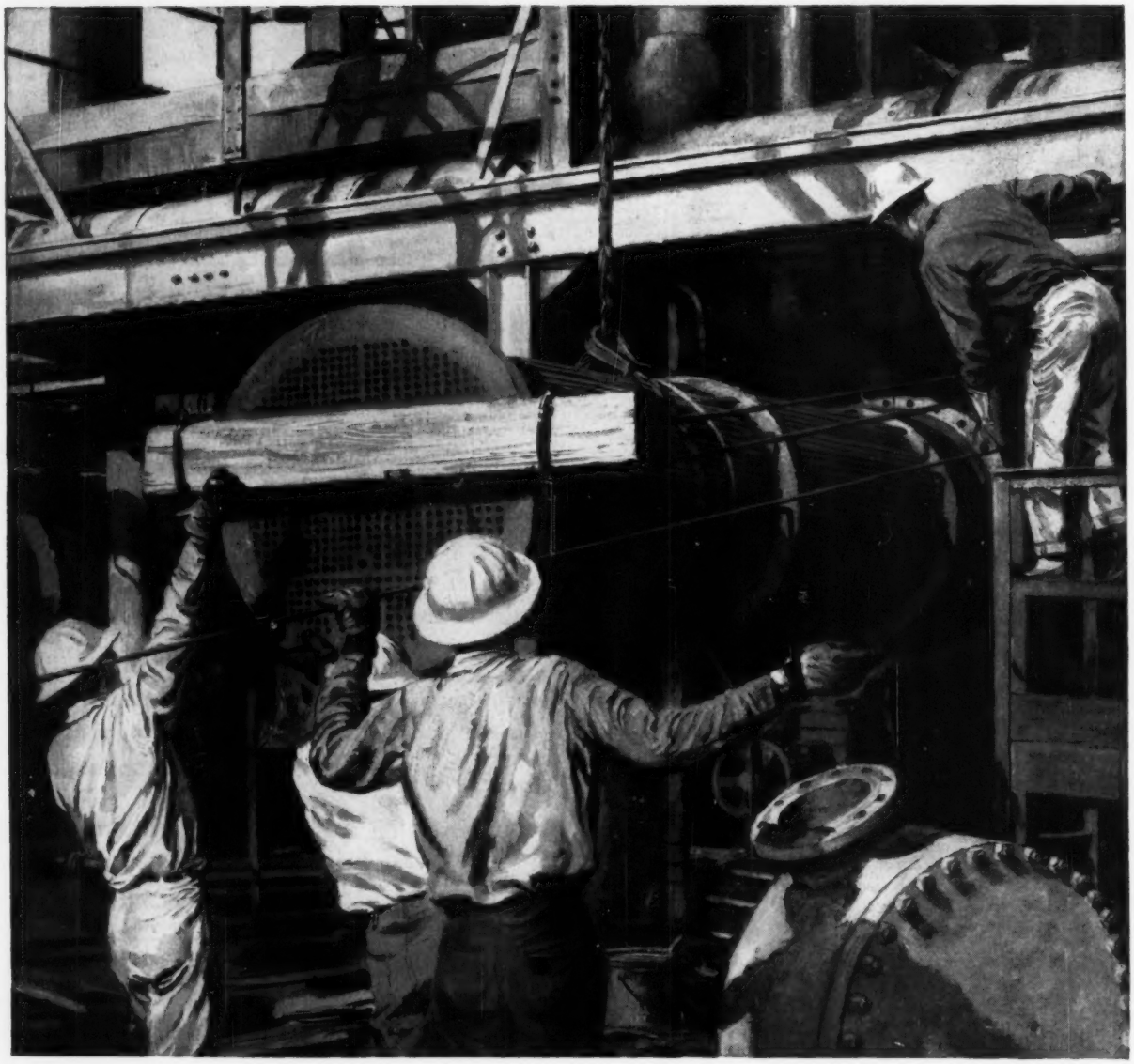
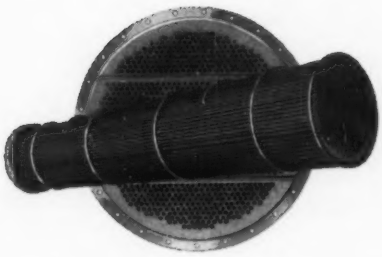
RETUBE YOUR BUNDLES WITH

PHELPS DODGE HEAT EXCHANGER AND CONDENSER TUBES

FOR LONG-RUN RELIABILITY!





- Wide range of finest quality copper-base alloys—bi-metal combinations—to fit your application needs.
- Well-stocked, nation-wide warehouses at Houston, Tulsa, Los Angeles and Bayway, N. J.
- Experienced engineering staff at your service to help solve tube corrosion problems.

Specify Phelps Dodge . . . a leading manufacturer of tubes for the fabricators of heat exchangers and condensers!

PHELPS DODGE COPPER PRODUCTS CORPORATION

PHELPS DODGE COPPER PRODUCTS CORPORATION

SALES OFFICES: Atlanta, Birmingham, Ala., Cambridge, Mass., Charlotte, Chicago, Cincinnati, Cleveland, Dallas, Dayton, Denver, Detroit, Fort Wayne, Greensboro, N. C., Houston, Indianapolis, Jacksonville, Kansas City, Mo., Los Angeles, Memphis, Milwaukee, Minneapolis, New Orleans, New York, Philadelphia, Pittsburgh, Portland, Ore., Richmond, Rochester, N. Y., San Francisco, St. Louis, Seattle, Washington, D. C.

FIRST FOR LASTING QUALITY—FROM MINE TO MARKET!

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SERIES 40 GOBBLES UP EXTRA HEAVY CONDENSATE LOADS

This "thirsty" Yarway Impulse Steam Trap gives you all the well-known Yarway advantages like *quick heat-up, even temperatures, small size, good for all pressures, non-freezing*—PLUS the added feature of *huge capacity.*

For example, at 100 psig the ¾" size will handle 5600 lbs/hr; the 2½" size, 62,000 lbs/hr.

Specify the Yarway Series 40 Trap for applications on large autoclaves, cooking kettles, heat exchangers, heating coils and other places where loads are heavy.

Buy the Yarway Series 40 from your nearby Industrial Distributor—more than 270 stock and sell the Yarway line. Over 1,250,000 Yarway Impulse Steam Traps already sold.

YARNALL-WARING COMPANY
128 Mermaid Ave., Philadelphia 18, Pa.

SERIES 60—normal needs, pressures to 400 psi, 6 sizes. **SERIES 120**—normal needs, pressures to 600 psi, 6 sizes. **SERIES 40**—for extra heavy loads, 5 sizes. **NO. 30**—for extra light loads (½" only). **INTEGRAL STRAINER**—highest pressures and marine use, 6 sizes.

YARWAY | *impulse® steam traps*

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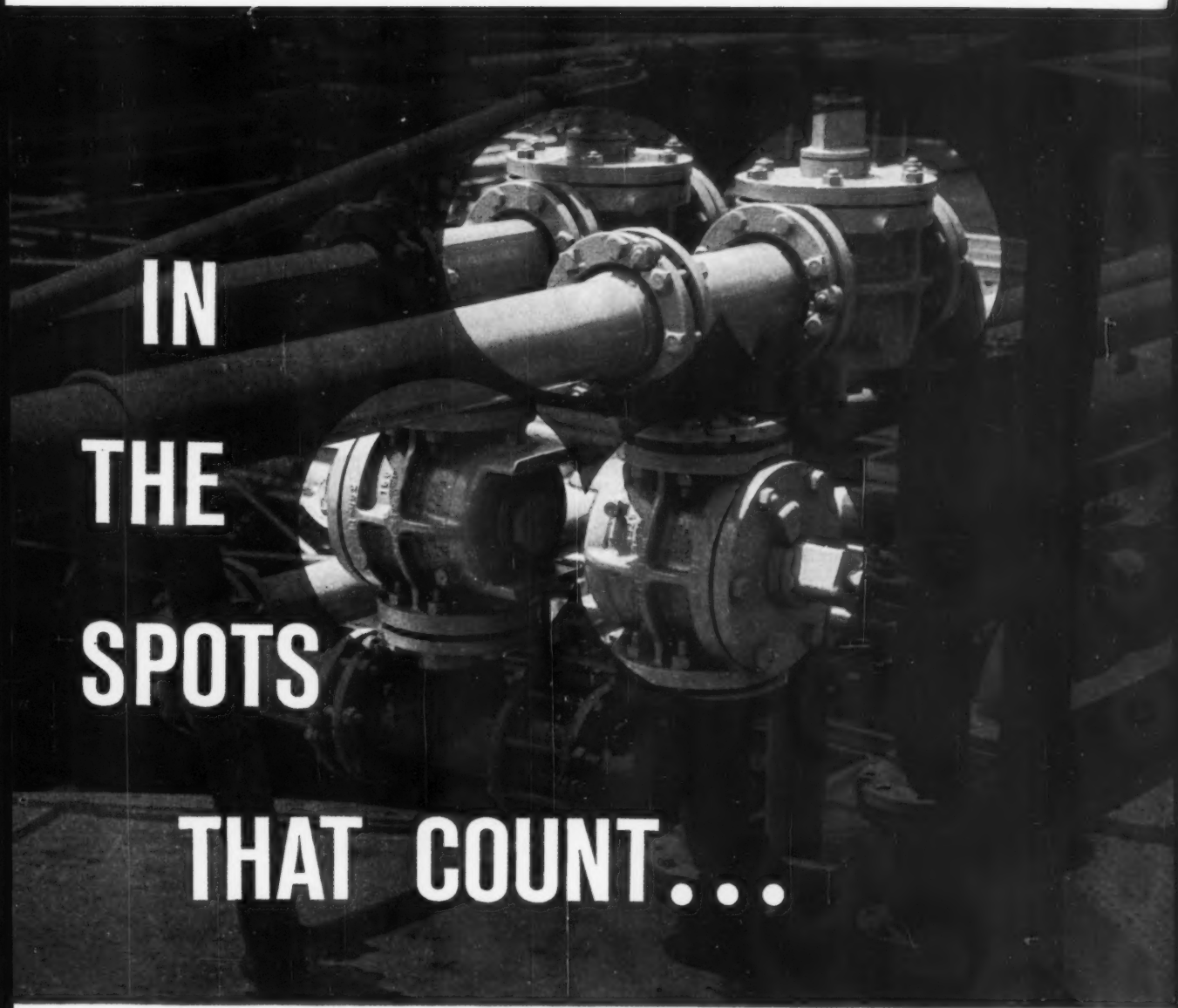


Goodyear specifies Homestead Valves for non-contamination of GR-S latex rubber

Through the round ports of Homestead Lubricated Plug Valves at Goodyear Tire and Rubber Company's synthetic rubber plant in Houston, Texas, flow dilute solutions of GR-S latex rubber at 80 p.s.i. and 100° F.

Fluid solutions never lodge and build up in the line since Homestead Round Port Valves provide full circular opening through plug and body of the valve —same size as the pipe they serve.

A letter or the coupon below will bring you further information on this installation. You may also receive complete details on low first cost, low maintenance, Homestead Valves in our catalog 39-1.

Controlled pressurized lubrication plus extremely close tolerances between plug and body assure lubrication of all sealing surfaces without contamination of line fluids.

hv

HOMESTEAD VALVE MANUFACTURING COMPANY
P. O. Box 45, Coraopolis, Pennsylvania

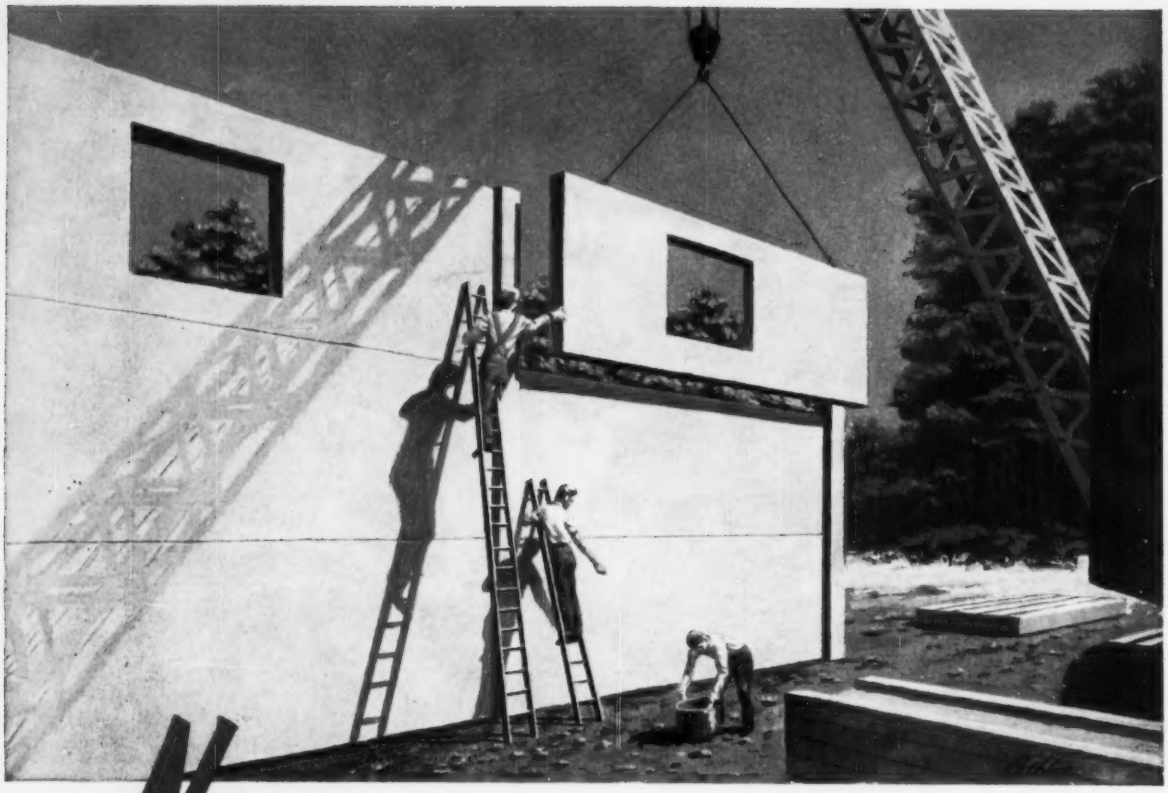
☐ Please send me catalog and prices on Homestead Lubricated Plug Valves.
☐ Send more facts about latex applications.

Name ..... Title .....

Company .....

Address .....

City ..... Zone ..... State .....



Now Permanent Concrete Buildings

DESIGN—Rackle provides professional assistance in building design and all phases of engineering.

MANUFACTURE—4000 to 5000 PSI lightweight Haydite concrete is conventionally reinforced and/or prestressed by Swiss-patented BBR system. Strict production and laboratory control insures positive strength in Rackle members.

DELIVERY—Rackle trucks deliver structural components to jobsite as soon as the foundation is poured.

ERECTION—Units are put into place as quickly as they are delivered. Columns are set first. Then beams. Finally channel roof deck. Small buildings can be set in 8 hours; a 30,000 sq. ft. warehouse in 40 to 60 hours.

FINISHING—Six inch thick pre-cast wall panels with plain or textured surfaces can be installed rapidly, or you can use any other architectural treatment you prefer.

From design to finished product, Rackle provides a complete concrete building engineered to individual specifications with speed and economy.

Erected in Hours!

Rackle's new engineering and production technique makes *extra speedy* construction possible with permanent, maintenance-free concrete.

Engineered and cast to individual specifications at our Houston plant, Rackle structural members are trucked to your building site and erected in a matter of hours.

Initial cost is surprisingly low because of speed of construction, and when you build with concrete you continue to save for many years because concrete requires little or no maintenance and insurance rates are lower, too.

Write or call today for literature on building with Rackle.

THE RACKLE COMPANY OF TEXAS

PO BOX 15008 • HOUSTON • OR 2-1736

Serving the Texas Gulf Coast Only

Manufacturers of quality concrete products since 1870 . . . a wholly owned subsidiary of the Geo-Rackle and Sons Co., Cleveland, Ohio.

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what's the secret

why is Caposite so strong?

It's no secret why CAPOSITE insulation is so strong and stands up to such rough usage. These pipe sections and blocks are made wholly of Amosite asbestos and the long fibres of this particular kind of asbestos give CAPOSITE its strength and resilience as well as its high insulating value. This exceptional strength leads to many other features besides long life; it means that larger sizes of pipe sections and blocks are possible, making application easier and faster. Less care is needed in handling the material. Unlike other moulded insulation, CAPOSITE, because of its strength, can be shipped to refineries anywhere in the world *in cardboard cartons*, showing big savings in freight and storage costs.

CAPOSITE Regd.

ASBESTOS INSULATION

THE CAPE ASBESTOS COMPANY LIMITED, 114 & 116 PARK STREET, LONDON W1 Tel: Grosvenor 6022 Cables: Incorrupt London

Enquiries in Canada to: Cape Asbestos (Canada) Limited, 200 Bloor Street East, Toronto, Ontario
U.S.A.: North American Asbestos Corporation, Board of Trade Building, Chicago 4, Illinois

TA 10443

Gasoline plant changes valves . . . ends leaks . . . saves money

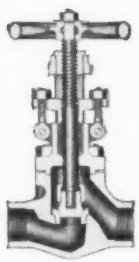
Crane Valves Stop Trouble in Severe Blowdown Service

This large Southwestern gasoline plant was troubled by leaky plug type valves used on 900-pound blowdown service lines from gas scrubbers. Water, scale, dirt and other foreign matter cut out the plugs and seats. Valve maintenance costs rose and scrubber efficiency dropped.

It's more than a year since the plant replaced the more costly plug type valves with Crane 1-inch, 600-pound forged steel globe valves. Today these Crane valves, operated several times daily, continue to seat tightly.

With the leakage problem licked, the plant has saved money on maintenance, and improved the efficiency of scrubber operations.

Got a leaky valve problem of your own? Your Crane Man will have the economical answer. He and Crane have been providing solutions to valve and fittings problems for many years—all based on thorough knowledge of oil and gas industry needs . . . Crane know-how in design and manufacturing . . . Crane dependable quality. Take it up with your Crane Man on his next call.

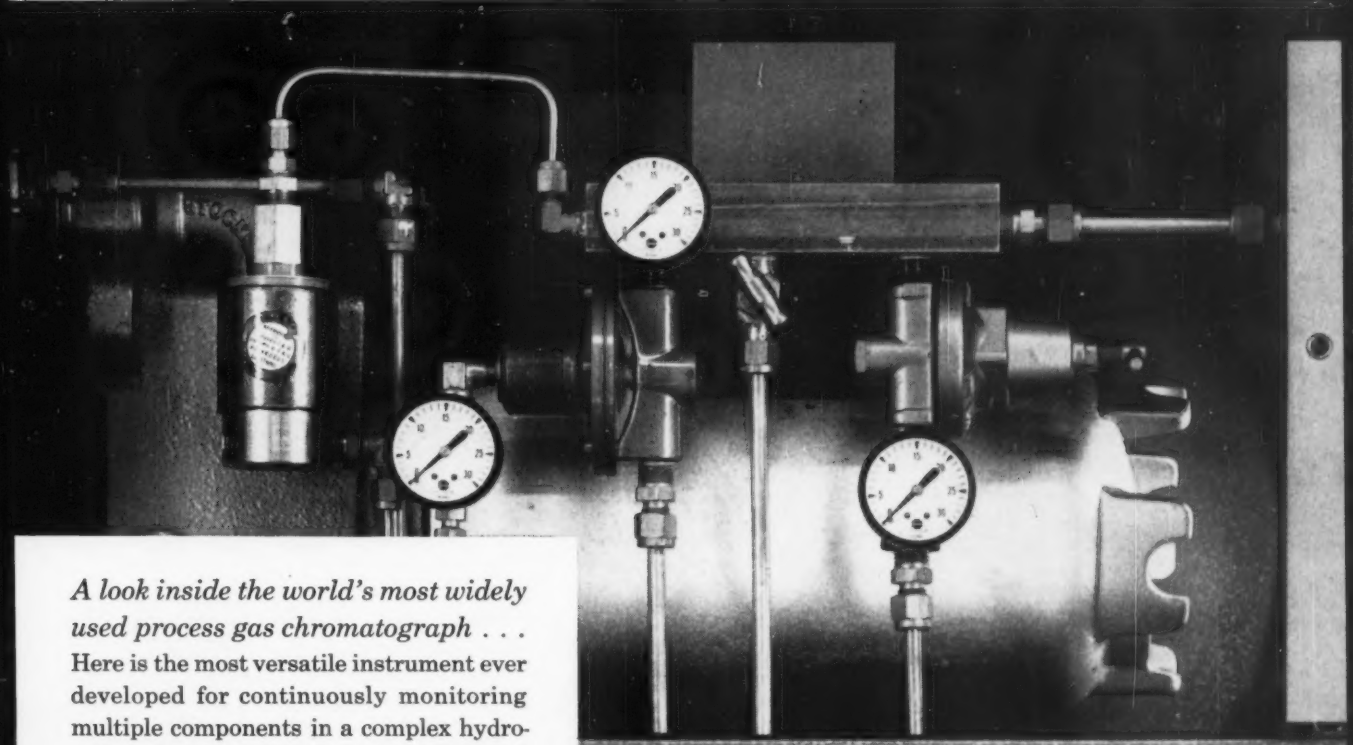


Rugged Crane 600-pound globe valve seating is famous for resistance to foreign matter and wire-drawing. Better design and materials do it!

CRANE® VALVES & FITTINGS

PIPE • PLUMBING • HEATING • AIR CONDITIONING

Since 1855—Crane Co., General Offices: Chicago 5, Ill.—Branches and Wholesalers Serving All Areas



A look inside the world's most widely used process gas chromatograph . . .
Here is the most versatile instrument ever developed for continuously monitoring multiple components in a complex hydrocarbon stream... the Beckman Industrial Gas Chromatograph. Its pneumatic heating system, in an explosion-proof housing, provides close temperature control (±.1°C.) for long-term analysis reproducibility. Accessible design simplifies and speeds adjustment when required. And accessories broaden its range of refining applications. ⌘ Application engineers run new instruments on samples from your stream to guarantee performance on your process ...*before* delivery. Beckman Industrial Gas Chromatographs are delivered ready to go, with start-up a regular service. ⌘ The result is continuous, trouble-free operation on a variety of refining streams to give vital information for process control ... the real reason why Beckman Process Chromatographs outsell all others combined. ⌘ For detailed instrument specifications and answers to your process control problems... write for data file 3P-3-25.

Beckman
Scientific and Process Instruments Division
Beckman Instruments, Inc.
2500 Fullerton Road,
Fullerton, California

It's a Fact: While a cat cracker produced enough gasoline to power every automobile in the U.S. for 200 miles, a Beckman Oxygen Analyzer continuously monitored the catalyst regeneration with only routine cleaning and adjustment required.

When you consider expansion... the most important investment you can make is in the creative ability of men.

FLUOR

Engineers and Constructors

Design in three dimensions

At Fluor's Los Angeles headquarters, there is an 8,000-square-foot building where 30 plant designers work with 20 professional modelmakers. Drafting tables are within 10 feet of model assembly tables. Another building contains an elaborate photographic studio where precisely scaled isometric and plan views can be taken under shadowless lighting.

All this began seven years ago when Fluor engineers built a scale model and rigged miniature hoists to solve a difficult erection problem. Success of this trial led to experiments with the use of models as a basic design tool. Cost studies showed substantial savings in drafting man-hours (net savings, above modelmaking costs.)

Today, models are to be found in most of Fluor's drafting rooms, and nearly all Fluor-built plants are designed with the aid of this tool. Beyond the dollar savings there are many less tangible benefits. Sizable groups can confer over a model, reach quick agreement on layouts, approve or revise many details at a single session.

Piping runs are shorter and more direct, valves and instruments are more accessible when designers lay them out on a model (a Fluor comparison study of a refinery design showed a $50,000 saving in pipe, fittings and fabrication by use of a model vs. conventional layout drawings.)

Costly revisions are minimized when many specialists can study a complete plant in miniature before construction begins. In the field, models serve as a reference for construction crews and a guide for operator training.

Unless scale models are properly used—as a basic, integrated design tool—most of these advantages are lost. The development and refinement by Fluor of design techniques using scale models has been a creative contribution to the engineering and construction industry.

For more information on the use of scale models in design and construction, write to Dept. 35, The Fluor Corporation, Ltd., 2500 South Atlantic Boulevard, Los Angeles 22, California.

ENGINEERS "DISCOVER" ALCOA CONDUIT

Lower cost, installation economies, corrosion resistance make Alcoa Aluminum the best conduit buy

An increasing number of cost-conscious engineers are switching to aluminum rigid conduit for office buildings, industrial plants and other new and remodeled structures. Here are some of the reasons why:

- Lower prices plus light weight and ease in handling make Alcoa® Aluminum Conduit installations competitive.
- Corrosion resistance of aluminum means less maintenance, freedom from staining.
- Aluminum is easier to cut, bend and thread. Wire pulling is easy, too, because of specially treated internal surface.
- Nonmagnetic aluminum offers up to 20 per cent less voltage drop.
- Clean, modern appearance complements modern architecture.
- Aluminum is nonsparking and has Underwriters' Laboratories, Inc., approval.

Find out why Alcoa Aluminum is your best conduit buy. Contact your electrical distributor, or write Aluminum Company of America, 2144-C Alcoa Building, Pittsburgh 19, Pennsylvania.

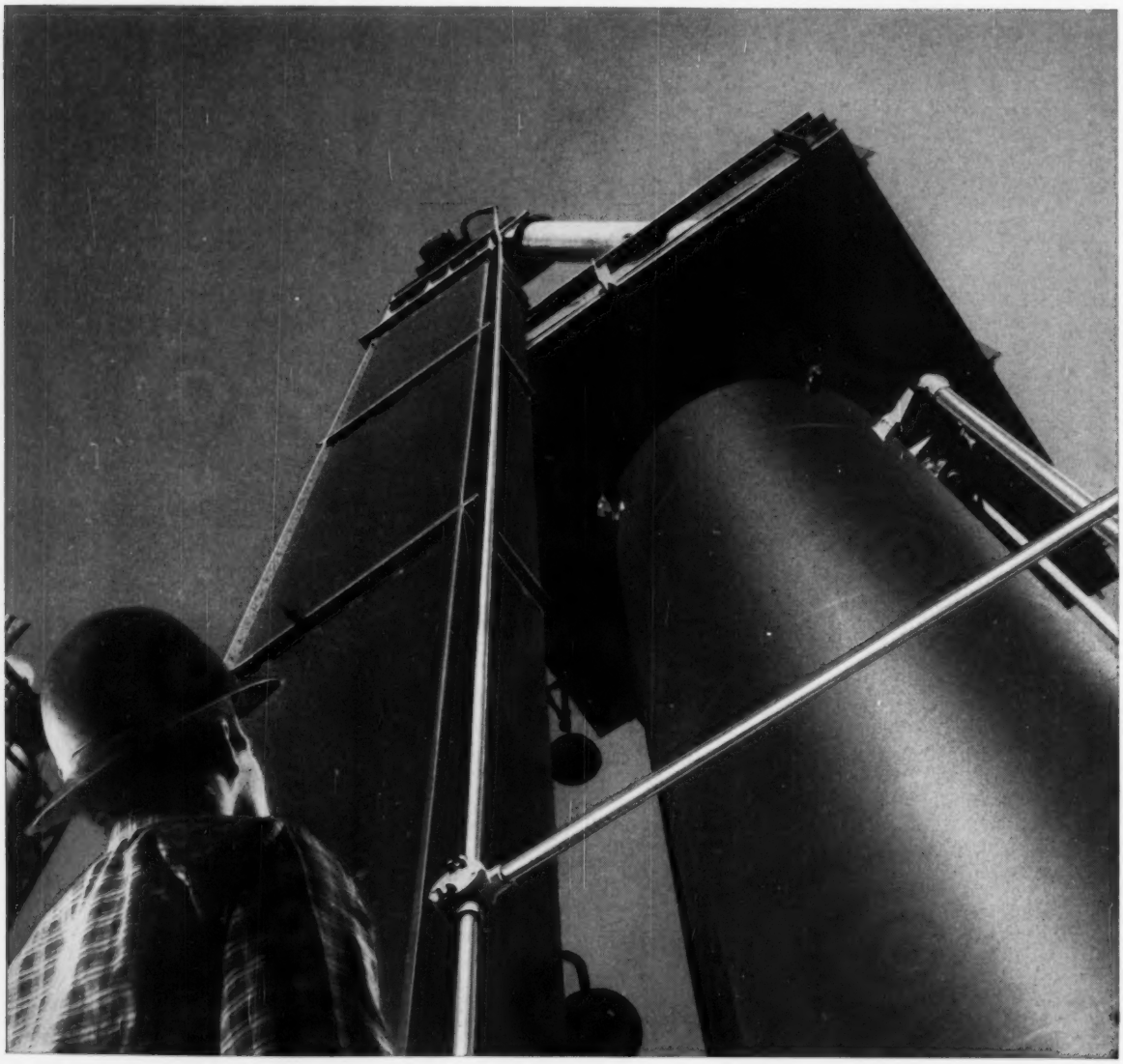
ALCOA ALUMINUM

Underwriters' Laboratories, Inc. INSPECTED RIGID CONDUIT ISSUE MU-28

Your Guide to the Best in Aluminum Value

For Exciting Drama Watch "Alcoa Theatre," Alternate Mondays, NBC-TV and "Alcoa Presents," Every Tuesday, ABC-TV

Clark Oil and Refining, Blue Island, Illinois



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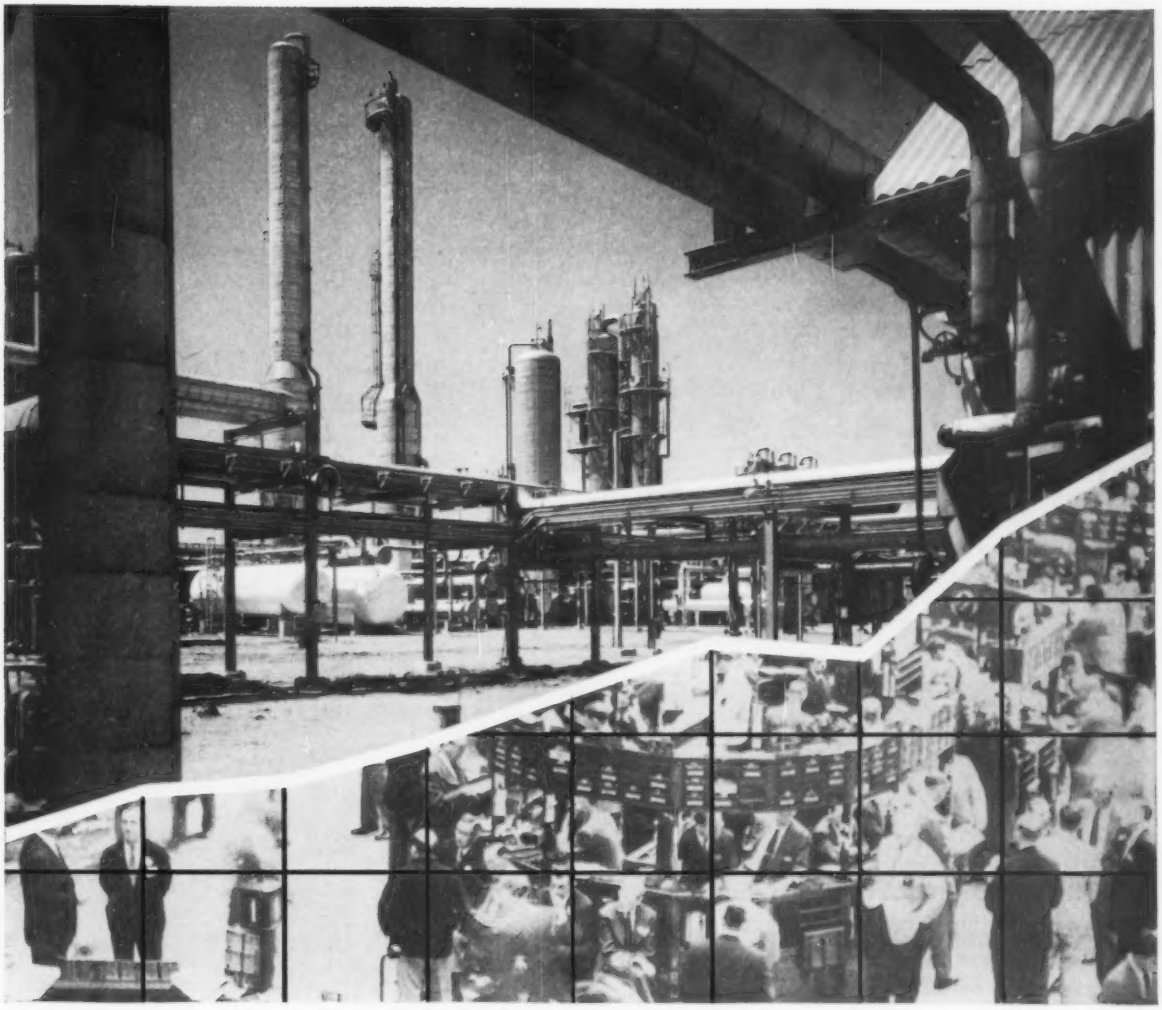

Pritchard's solution to volume hydrocarbon recovery...

with, above all, GOOD FINANCIAL DESIGN

One of the largest petro-chemical plants ever built – National Petro-Chemical Corporation's Tuscola plant–has changed an entire industry's thinking about hydrocarbon recovery. Designed and built by J. F. Pritchard & Company, Tuscola extracts ethane, propane and butane from natural gas using an oil absorption cycle in the extraction section shown above. The result: 50% more ethane per dollar invested than with low temperature condensation plants, and appreciably lower operating costs. Tuscola has set new profit potentials for the fuller utilization of natural gas.

Creative engineering as exemplified by Tuscola is only part of Pritchard's over-all approach to plant construction. Pritchard services – ranging from economic surveys to delivery of a turnkey job – all focus on one main consideration: good financial design. Engineering and construction are our long suits – but profitable, on-stream operation is the basis of our reputation.

If you are planning new construction in the gas, petroleum, petro-chemical or power fields, give us an opportunity to show you how good financial design can work for you.

PROFITABLE FACILITIES THROUGH GOOD FINANCIAL DESIGN

J.F. Pritchard & Co.

ENGINEERS • CONSTRUCTORS

Dept. 409, 4625 Roanoke Parkway, Kansas City 12, Mo.

OFFICES IN CHICAGO, HOUSTON, PITTSBURGH, NEW YORK

SERVING THE GAS, POWER, PETROLEUM AND CHEMICAL INDUSTRIES

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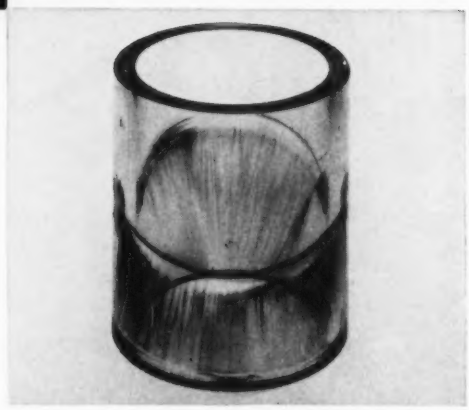
UNICOR®-LHS

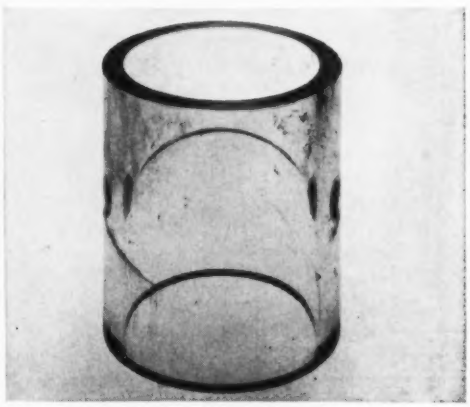
Highest Detergent Activity in an Anti-Icing Agent

The three photos on the right were taken of glass throttle bodies at the conclusion of a carburetor cleanliness test in which the additives, at low anti-icing dosages, were compared on an equal cost basis.



No additive

Best competitive detergent additive



Unicor-LHS

Sure-fire prevention of carburetor icing—*plus* positive prevention of carburetor clogging! That's what you give your customers when you safeguard your gasoline by adding Unicor-LHS.

In addition to its well-known anti-icing and corrosion-protective characteristics, Unicor-LHS provides ideal detergency action. Recent tests at Universal's laboratories (see photos at right) demonstrate that Unicor-LHS imparts greater detergency to your fuel than the best competing additives.

Convenient and economical to use, this anti-icing additive can be introduced anywhere—refinery, bulk plant or filling station—at less than half the cost of ordinary anti-icers.

We shall be glad to determine the exact anti-icing and carburetor detergency requirements of your fuels.

For detailed information, samples, or commercial quantities, write to our Products Department.

UNIVERSAL OIL PRODUCTS COMPANY
30 Algonquin Road, Des Plaines, Illinois, U.S.A.
More Than Forty Years Of Leadership In Petroleum Refining Technology

For more data on advertised products, use Readers' Service Cards, last page.

POTENTIAL

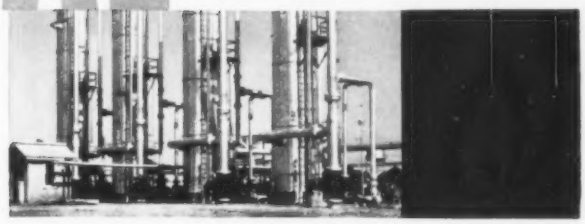
1. FABRICATION of all types of equipment (Fractionating Columns, Gas Columns, Pressure Vessels, Plate and Heavy Steel Work, Special Machines, Autoclaves, Shells, Bridge Girders) is performed to order, to specification.

2. MACHINING—Fully equipped, flexible facilities for machining to close tolerances, regardless of product size or design.

3. STAINLESS—Separate, integrated shop for stainless fabrication protects against contamination by ordinary steel.

4. DELIVERY by rail, truck or inland, coastal or overseas waterway.

1 FABRICATION



2 MACHINING

3 STAINLESS

4 DELIVERY

Through integrated, efficient operation, Sun Ship can reduce costs, increase your POTENTIAL. Call for an estimator or representative.

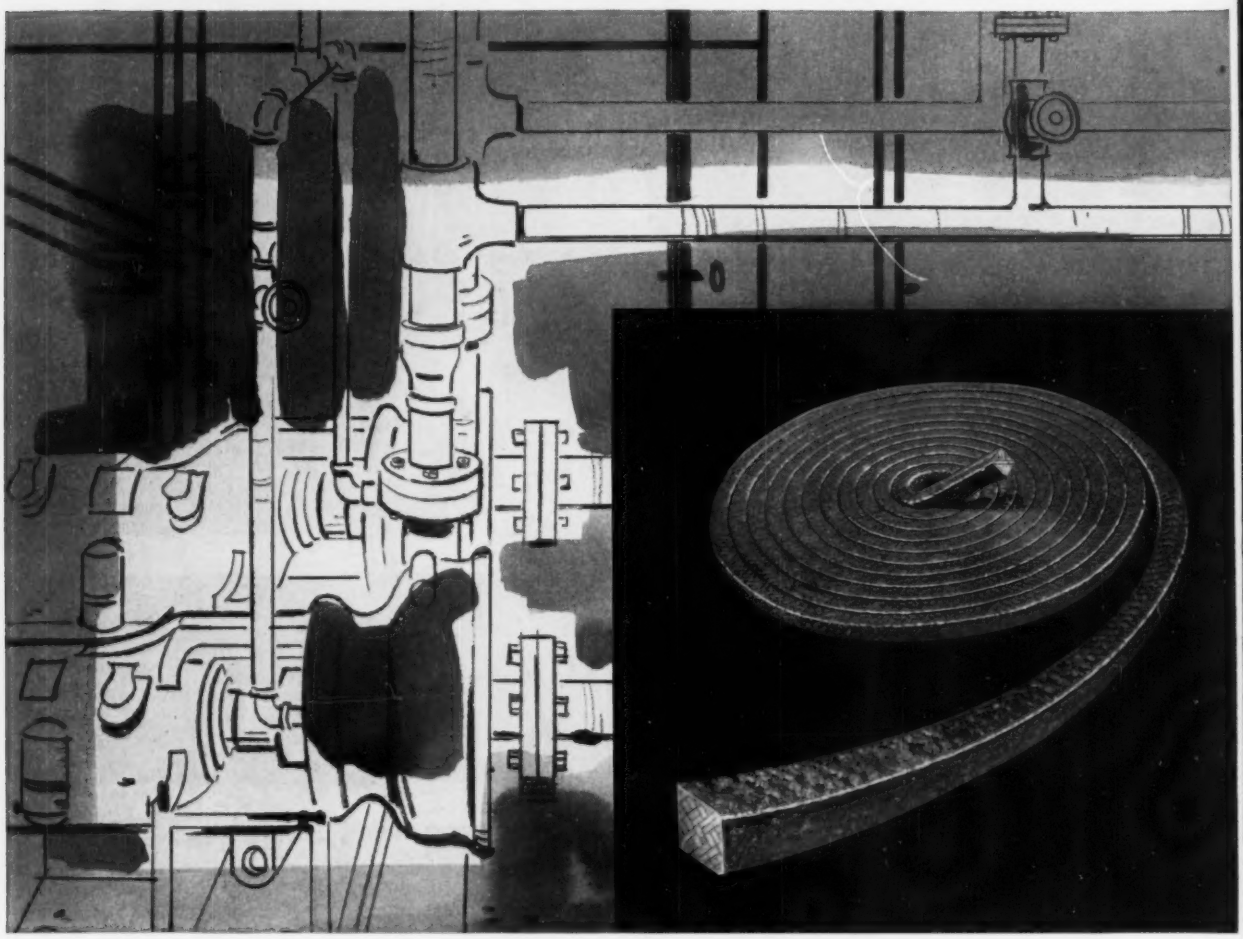
Sun

SHIPBUILDING & DRY DOCK COMPANY

ON THE DELAWARE • SINCE 1916 • CHESTER, PA.

For more data on advertised products, use Readers' Service Cards, last page.

What Garlock Salesmen tell



"LATTICE-BRAID* TEFLON† PACKING IS YOUR BEST BET FOR PUMPS AND ENGINES"

"LATTICE-BRAID TEFLON is just about perfect for oil, gas and petro-chemical service—it's a strong, long-lasting, chemically-inert packing that reduces maintenance and downtime. Let me show you what I mean.

"With LATTICE-BRAID packing, each strand passes diagonally through the body of the packing at a 45° angle. This through-and-through braiding makes a completely unified structure of *greater strength*. Ordinary braided packings become worthless once the single outer cover is worn through. On LATTICE-BRAID, there is no single outer cover; thus, the braiding holds together far beyond the limits of other packings. This, obviously, results in *longer life*.

"On top of this, you have the advantage of TEFLON. It is completely unaffected by the strongest acids, solvents, and alkalies. Co-efficient of friction is extremely low, and it will withstand temperatures ranging from −90° F to +500° F.

"One customer repacked every two weeks on a solvent recovery pump application. He changed to LATTICE-BRAID TEFLON over two years ago and hasn't repacked since."

Garlock can furnish you with LATTICE-BRAID packing in a variety of sizes and styles depending on what you need. If you have a particular problem, call our sales office in your area. Or, you can write for further information. Ask for Catalog AD-131.

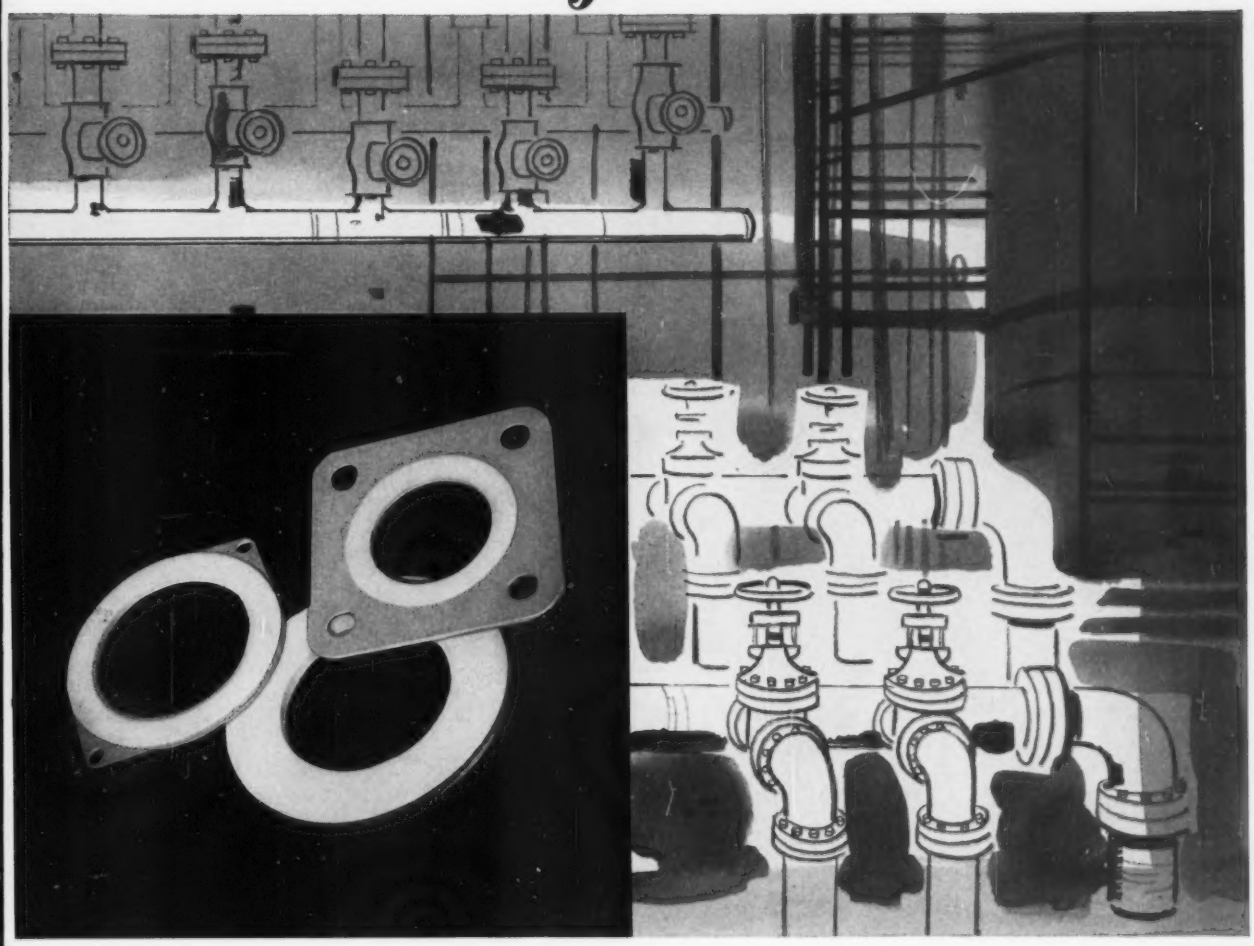
*Registered Trademark
†DuPont Trademark

GARLOCK

Packings, Gaskets, Oil Seals, Mechanical Seals,
Molded and Extruded Rubber, Plastic Products

For more data on advertised products, use Readers' Service Cards, last page.

Petroleum Engineers



"BUY LONG-LASTING TEFLON GASKETS FOR PIPING, FLANGES AND FITTINGS"

"With TEFLON jacketed gaskets the outstanding advantage is that you get the fine qualities of TEFLON without sacrificing resiliency and deformability. This, of course, is extremely important on your glass-lined steel piping and process equipment, light metal flanges, and glass pipe flanges and fittings.

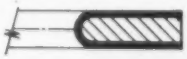
"The first step in choosing the proper gasket is to select the type which will work best for you. TEFLON-jacketed gaskets come in four basic designs:

"Once this design is chosen, it's a matter of considering the filler material and thickness. For example, for high pressures, a corrugated stainless steel filler is suggested. Where the application is for glass-lined steel connections with low bolt loads, a rubber filler should be sandwiched between woven asbestos cloth. We offer many different types of fillers, depending on what you need—rubber, asbestos, cork, etc."

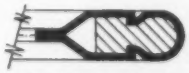
Why not let our representative in your area help you select the right gasket design? Discuss your problem with him or write for our Catalog AD-154.

A: Slit Envelope. Teflon stock slit from outside diameter to within 1/8" of inside diameter.

B: Milled Envelope. Teflon stock machined from outside diameter to within 1/32" of inside diameter. Gasket I.D. does not interfere with process flow.



C: Formed Shield for large diameters and irregular opening such as elliptical manholes.



D: Double Jacket. Two jackets overlapping to protect O.D. as well as I.D. For glass-lined steel nozzles.

THE GARLOCK PACKING COMPANY, Palmyra, N. Y. For Prompt Service, contact one of our 30 sales offices and warehouses throughout the U. S. and Canada.

CANADIAN DIVISION: The Garlock Packing Company of Canada Limited
PLASTICS DIVISION: United States Gasket Company

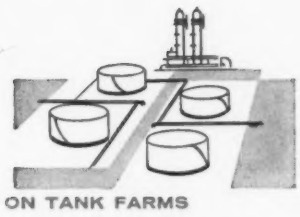
WON'T BURN! WON'T SHRINK! WON'T THERMAL-SHOCK!

UNARCO®

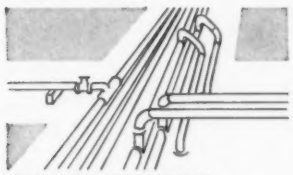
UNIBESTOS®

—the pipe insulation that's worth more money

There's never a peep from installation or maintenance crews—or from the front office—when UNIBESTOS is specified. It cuts and fits easily...goes-on faster...takes all the heat it's designed for. Sizes to 44" o.d. Temperatures to 1200°F. Write for Catalog F76-321 with exclusive "J" Factor Tables. Union Asbestos & Rubber Company, General Sales Offices: 1111 W. Perry St., Bloomington, Illinois. Distributors in principal cities.



ON TANK FARMS



AROUND PIPELINES

AT WELL SITES

stop weeds and fires before they start

get preventive weed control with

GEIGY SIMAZINE* 50W

pre-emergence residual herbicide with

7 SAFETY FEATURES

Weed control is an old problem to the petroleum industry. Now Geigy's pre-emergence herbicide Simazine 50W provides a new and better solution – makes weed control *easier* because it is long residual; *safer* because of its Seven Safety Features; and *more effective* because it stops weeds before they start.

ONE APPLICATION PER SEASON

At the rate of 20 lbs. per acre, one pre-emergence application of Simazine 50W controls most annual broadleaf weeds and grasses for an entire season. For longer residual control, or for control of more resistant perennials, use 30 to 40 lbs. per acre.

SEVEN SAFETY FEATURES

Oil maintenance men especially appreciate Simazine 50W's Seven Safety Features. This new herbicide is safe to humans and animals, non-flammable, non-corrosive, non-abrasive, and presents no conductivity problem or drift hazard. Check the panel for these and all of Simazine 50W's Seven Safety Features – and compare.

TECHNICAL SERVICE

Geigy Technical Service is readily available to serve you. Write for additional information, the name of your nearest Simazine 50W distributor, or ask to see a Geigy technical representative. Address: Geigy Agricultural Chemicals, P.O. Box, 430, Yonkers, N. Y.

1. **SAFETY TO HUMANS AND ANIMALS**
   Extremely low toxicity. No need for protective clothing.
2. **SAFETY TO ADJACENT VEGETATION**
   Minimum lateral leaching. Remains where it is applied.
3. **SAFETY TO SPRAYING EQUIPMENT**
   Non-corrosive or abrasive to equipment.
4. **SAFETY NEAR ELECTRICITY**
   Relatively low electrical conductivity.
5. **SAFETY FROM DRIFT HAZARD**
   Works through roots—little or no toxicity to foliage.
6. **SAFETY FROM FIRE HAZARD**
   Non-flammable. No application hazard.
7. **SAFETY ON VALUABLE LAND**
   Not a permanent soil sterilant.

ORIGINATORS OF Geigy DDT INSECTICIDES

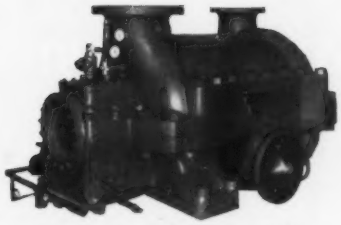
* "SIMAZINE" is a trademark of Geigy Chemical Corporation

GEIGY AGRICULTURAL CHEMICALS • *Division of Geigy Chemical Corporation* • Saw Mill River Road, Ardsley, N. Y.

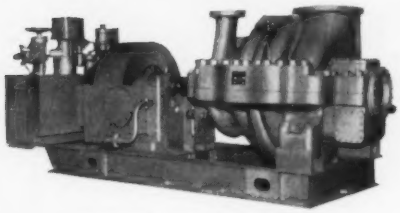
For more data on advertised products, use Readers' Service Cards, last page.

John L. Parris, *Manager Centrifugal Compressor Sales, The Cooper-Bessemer Corporation, explains...*

How you gain four ways when you specify Cooper-Bessemer Centrifugal Compressors

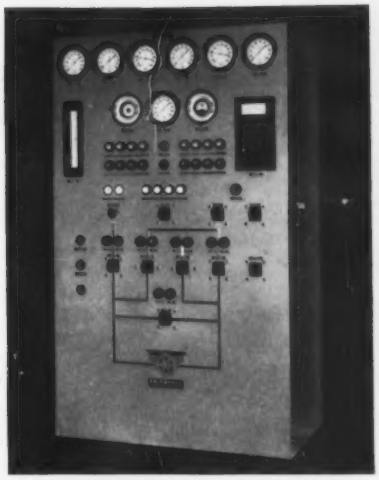


Horizontally split, process air or gas centrifugal compressor. Range: Up to 100,000 cfm.

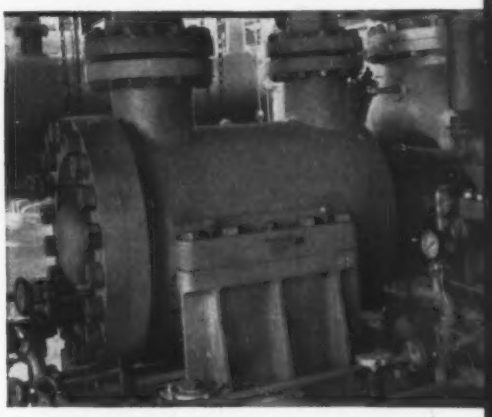


Horizontally split, intercooled centrifugal compressor designed for low cost shop and process air and gas. Up to 30,000 cfm.

Pipeline centrifugal booster with a history of record-breaking performance. Up to 20,000 bhp.



Installations can be integrated with Cooper-Bessemer En-Tronic Controls all the way from simple monitoring to complete system automation.



Barrel type centrifugal compressor for gas and air at pressures up to 5000 psi.

To get the most for your compressor dollars, it will pay you to check into Cooper-Bessemer Centrifugal Compressors because these fully-proved products offer you a combination of four outstanding advantages:

1. You get a design that's matched to your needs. A wide range of types and sizes of Cooper-Bessemer Centrifugal Compressors are available to assure optimum performance on *your* processing or air supply application.

2. You get unsurpassed quality. The designs include many field-proven distinctive features. Cooper-Bessemer's high standards of materials and craftsmanship are applied to every component of these precision-built units . . . to assure utmost reliability.

3. You can get undivided responsibility. We can engineer the entire compressor installation, including drive and controls. Cooper-Bessemer En-Tronic Controls are available to provide any degree of automation.

4. You get service for most profitable performance. Our outstanding field service and warehouse facilities assure prompt attention to your operating needs . . . with resulting reduction in your inventory and downtime.

Our nearest office will gladly supply complete information on Cooper-Bessemer Centrifugal Compressors to meet your needs exactly. Call them today.

BRANCH OFFICES: Grove City • New York • Chicago • Washington San Francisco • Los Angeles • Houston • Dallas • Odessa • Pampa Greggton • Seattle • Tulsa • St. Louis • Kansas City • Minneapolis New Orleans • Shreveport • Casper

SUBSIDIARIES: Cooper-Bessemer of Canada, Ltd. . . . Edmonton • Calgary Toronto • Halifax

Cooper-Bessemer International Corporation . . . New York • Caracas Mexico City

C-B Southern, Inc. . . . Houston

Cooper Bessemer

GENERAL OFFICES: MOUNT VERNON, OHIO

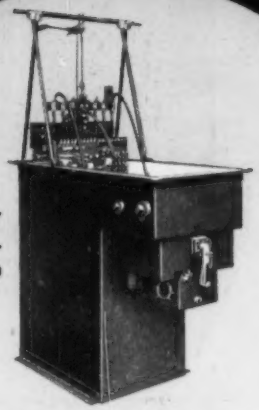
ENGINES · GAS · DIESEL · GAS-DIESEL
COMPRESSORS: RECIPROCATING AND CENTRIFUGAL, ENGINE OR MOTOR DRIVEN

EC&M's LINE OF HIGH VOLTAGE STARTERS GIVES YOU

*EXACTLY the Right Starter for Any Location!**

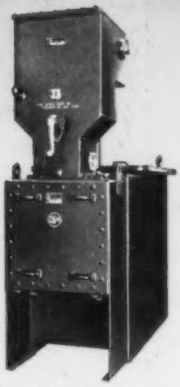
* Hazardous Location, Class I, Group D, Divisions 1 and 2

TOTALLY OIL-IMMERSED



Type AT Combination Starter shown with Contactor and Overload Panel raised above the oil level without disconnecting any bolts or leads—in NEMA 3R enclosure for outdoor mounting, available in 50,000 KVA (certified) interrupting capacity.

OIL-IMMERSED

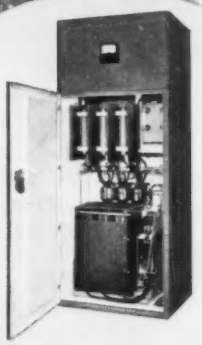


Type AM Combination Starter in NEMA 3R enclosure for indoor or outdoor locations—available in 50,000 KVA (certified) interrupting capacity —and VALIMITOR.®

OIL-BREAK

Type AH Combination Starter in NEMA 1 or 3R enclosures for indoor, outdoor or pressurized control room—available in 3 interrupting ratings, 50,000 KVA—POWER FUSED—and VALIMITOR.®

AIR-BREAK



Type AFG Combination Starter for Pressurized Control Rooms. Built in Class E1, Class E2 and VALIMITOR.®

For complete information write for Bulletin 8131-L

THE ELECTRIC CONTROLLER & MFG. CO.

A DIVISION OF THE SQUARE D COMPANY

CLEVELAND 28 • OHIO

7928-R

Permanent protection for costly insulation on fractionators and caustic washers at Phillips Petroleum Co. refinery at Sweeny, Texas, is provided by New Childers Deep Corrugated Jacketing with factory-attached moisture barrier.

Protection for the costly insulation on this caustic washer was applied in one easy operation because Childers Jacketing has factory-attached moisture barrier.

These gleaming aluminum-covered towers will always look new! No need to paint Childers Jacketing . . . a savings that alone may pay full cost of jacketing *plus* installation!

Why 724 plants specified this . . .

New Kind of Protection for Towers, Vessels & Tanks ...Childers Deep Corrugated Aluminum Jacketing:

Read why exclusive benefits of factory-attached moisture barrier are fast making Childers Jacketing the standard of the industry.

Only Childers gives you this special feature: Factory-Attached Moisture Barrier that (1) eliminates any danger of harm to the underneath side of the jacketing. And, (2) saves you time, labor and money because you apply jacketing with moisture barrier already attached . . . in one single operation.

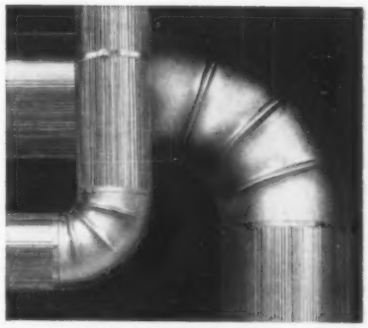
You also get greater strength and greater protection at less cost with Childers Cross-Crimp®. Tests prove the rolled-in 3/16″ cross corrugation increases the vertical strength and rigidity of .019″ thick aluminum to that of plain .032″ thick aluminum. Jacketing costs are consequently reduced as much as ⅓ when Childers Jacketing is used instead of ordinary sheet aluminum.

It's easy to install Childers Deep Corrugated Jacketing. Jacketing is applied with sheet metal screws used on both the vertical and circumferential lap. Screws may be omitted from circumferential lap when necessary to provide expansion joints.

Comes in two corrugations: 1¼″ and 2½″; and four thicknesses: .016″, .019″, .020″ and .024″. The .019″ and .024″ thicknesses are made from roofing alloy for maximum life—recommended for normal jacketing of towers, vessels, and tanks. The .016″ and .020″ thicknesses are available in #3003-H-14 alloy.

For a free sample of Childers Deep Corrugated Aluminum Jacketing with factory-attached moisture barrier, plus engineering data on how to safeguard your insulation, write to Childers Manufacturing Company, Dept. PR-44, P.O. Box 7467, Houston 8, Texas.

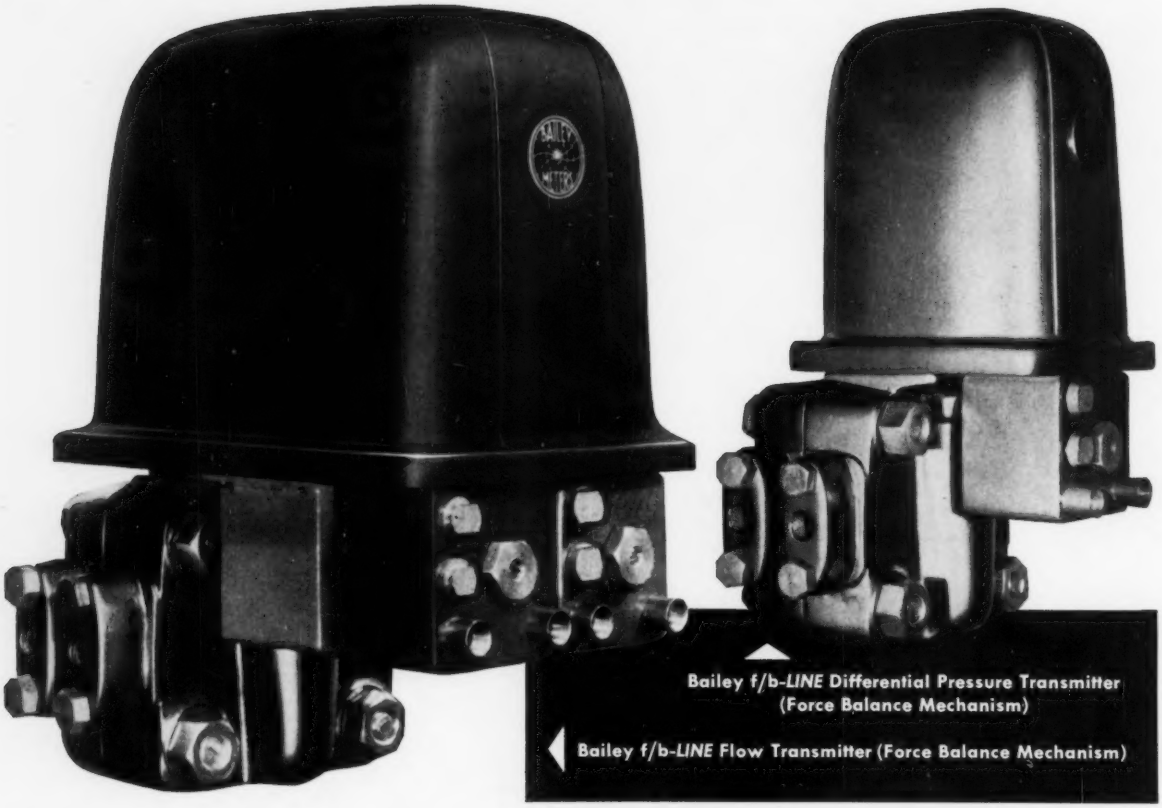
In Canada, write direct to Peerless Mfg. Co., Sub-Post Office 28, Calgary, Alberta.



For insulated lines Childers Aluminum Weather-Proof Jacketing in rolls goes on about 30% faster than ordinary weatherproofing, fits perfectly, never needs painting. Used with Childers exclusive 90° and 45° Ell-Jacs, this modern aluminum protection gives your insulated lines that well-dressed look from end to end.

Only Childers makes available to you complete specifications and engineering data on aluminum jacketing in these catalogs: Refinery Catalog pp. 317-320; Sweet's Industrial Construction File pp. 10b/Ch; Chemical Engineering Catalog pp. 1011-1014.

For more data on advertised products, use Readers' Service Cards, last page.



Bailey f/b-*LINE* Differential Pressure Transmitter (Force Balance Mechanism)

Bailey f/b-*LINE* Flow Transmitter (Force Balance Mechanism)

Two new Bailey *f/b-LINE* Transmitters

permit new accuracy in measuring flow and differential pressure

Pneumatically transmits rate of flow—or differential pressure—measurements to indicating, recording, and/or controlling equipment at remote stations. Transmitters consist of a diaphragm measuring mechanism and a force balance pneumatic transmitting unit.

APPLICATION

For steam, water, air, gases and other fluids producing differentials across primary elements from 0-2 in. H_2O to 0-2000 in. H_2O at maximum service pressure of 50, 1500, and 5000 psig.

FEATURES

Transmits a Signal Directly Proportional to Rate of Flow. Uses receiver with uniformly-graduated chart or scale. Eliminates need for external square-root extractors or characterizers.

10 to 1 Turndown. Differential range of each diaphragm measuring element may be changed by factor of 10 to 1; e.g., 0-20 in. H_2O diaphragm may also measure 0-2 in. H_2O.

Screwdriver Adjustments. Range and zero adjustments readily accessible. Range may be changed with screwdriver adjustment.

Overpressure Protection. Protects against full service pressure applied to either side of diaphragm.

Fast Response. No viscous dampers needed, so speed of response is very fast.

Corrosion Resistant. For maximum differentials between 20 and 2000" H_2O, all parts in contact with process fluid may be stainless steel. No sealing fluids or sealing diaphragm required.

Good Stability. Reset type boosters give good stability with high gain.

Versatile Mounting. May be mounted on process piping, wall, or separate mounting pipe using same bracket.

For additional information, call your local Bailey District Office, or write direct.

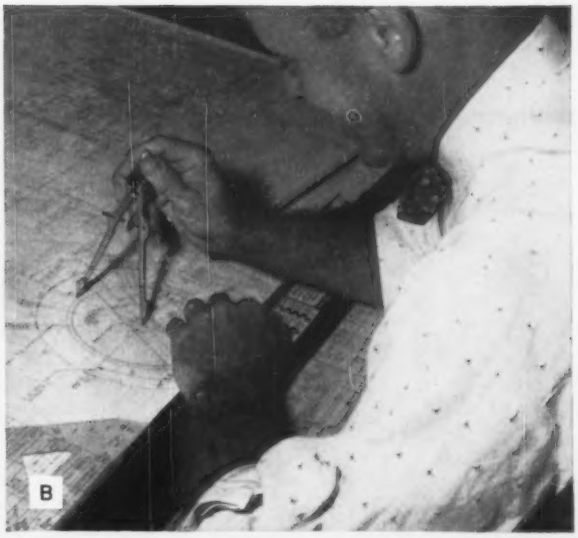
Chemical and petroleum division

BAILEY METER COMPANY

1043 IVANHOE ROAD • CLEVELAND 10, OHIO

In Canada—Bailey Meter Company Limited, Montreal

For more data on advertised products, use Readers' Service Cards, last page.



Where skillful hands work for you

Craftsmanship follows through on every stage of the design and fabrication of pressure vessels and heat exchangers at Downingtown Iron Works. Come and see for yourself. Inspect our shop procedures on work in normal progress. Or write for helpful Bulletins HE and CI.

A **On the nose**—Accurate fit-up...a second check after tack welding...another before shipment...assure nozzles are on the nose, save installation headaches.

B **Detailing your ideas**—in language the shop man understands—means that equipment fabricated here carries out your plans, meets your process requirements.

C **"X" marks the spot**—and punch mark guides true center of tube hole...holds close ligament tolerances... assures accurate tube sheets and efficient operation.

D **A Downingtown extra**—Back-chipping nozzle weld assures sound weld metal through and through...is one of the DIW extras that go beyond code requirements.

Downingtown Iron Works, Inc.

151 Wallace Ave., Downingtown, Pennsylvania

division of **PRESSED STEEL TANK COMPANY** Milwaukee

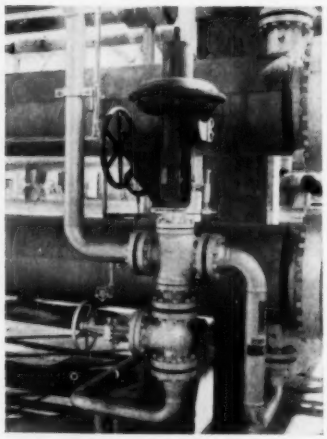
Branch offices in principal cities

HEAT EXCHANGERS—STEEL AND ALLOY PLATE FABRICATION
CONTAINERS AND PRESSURE VESSELS FOR GASES, LIQUIDS AND SOLIDS

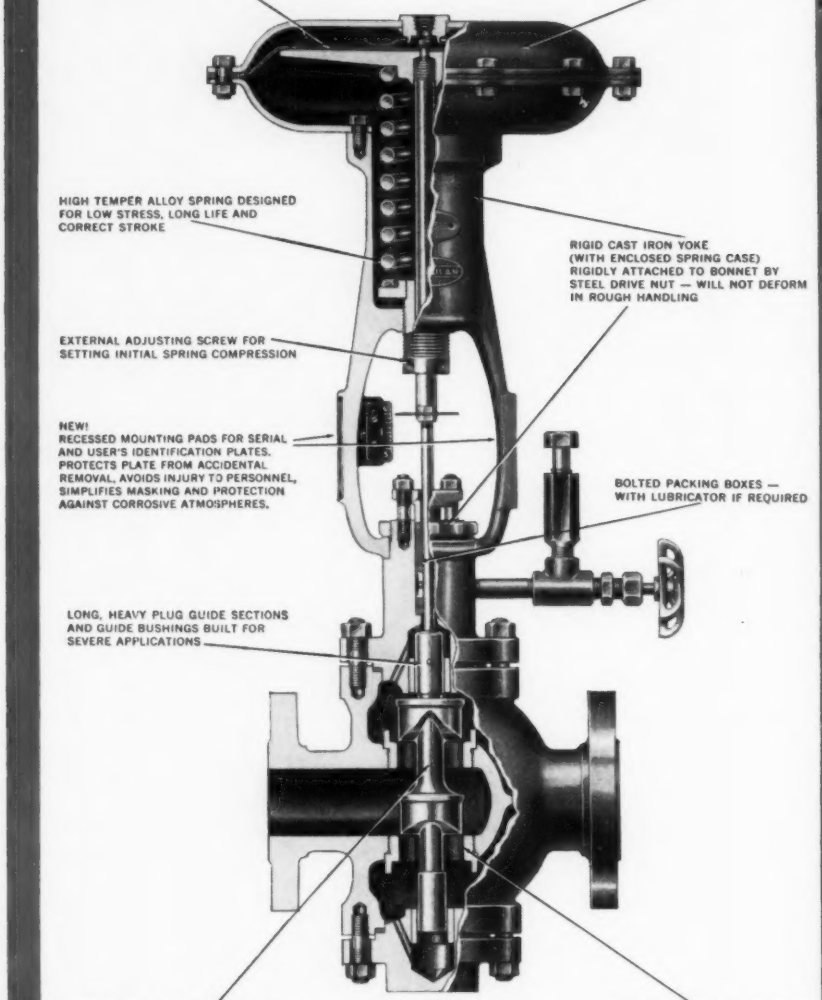
DOWNINGTOWN IRON WORKS INC. Hackney

For more data on advertised products, use Readers' Service Cards, last page.

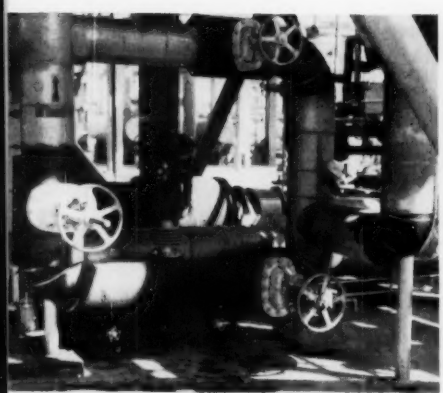
Crude Charge to Furnace



Reactor Effluent Flash Drum Control

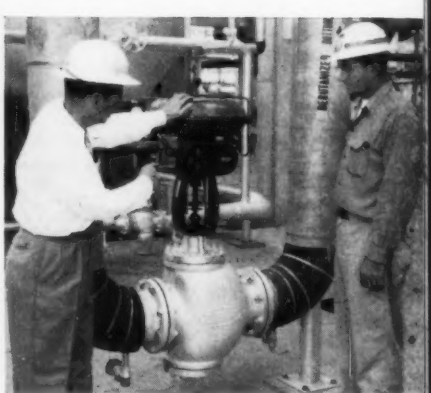

MOLDED NEOPRENE DIAPHRAGMS WITH LARGE EFFECTIVE AREAS FOR MAXIMUM POWER AND LONG STROKE
LARGE STEEL DIAPHRAGM CASES TREATED TO RESIST CORROSION
HIGH TEMPER ALLOY SPRING DESIGNED FOR LOW STRESS, LONG LIFE AND CORRECT STROKE
RIGID CAST IRON YOKE (WITH ENCLOSED SPRING CASE) RIGIDLY ATTACHED TO BONNET BY STEEL DRIVE NUT — WILL NOT DEFORM IN ROUGH HANDLING
EXTERNAL ADJUSTING SCREW FOR SETTING INITIAL SPRING COMPRESSION
NEW! RECESSED MOUNTING PADS FOR SERIAL AND USER'S IDENTIFICATION PLATES. PROTECTS PLATE FROM ACCIDENTAL REMOVAL, AVOIDS INJURY TO PERSONNEL, SIMPLIFIES MASKING AND PROTECTION AGAINST CORROSIVE ATMOSPHERES.
BOLTED PACKING BOXES — WITH LUBRICATOR IF REQUIRED
LONG, HEAVY PLUG GUIDE SECTIONS AND GUIDE BUSHINGS BUILT FOR SEVERE APPLICATIONS
WIDE VARIETY OF DOUBLE AND SINGLE SEATED PLUGS WITH DESIRABLE FLOW CHARACTERISTICS
HEAVY SEAT RING CONSTRUCTION PREVENTS DISTORTION — ASSURES TIGHT JOINT

A HIGH Quality Coefficient PRODUCT



Cat-Cracker Feed Control

Gas to Fuel Drum and Flare Drum



Debutanizer Bottoms Control

In the Final Control Element . . .

ACCURACY AND DEPENDABILITY ARE KEY QUALITIES

That's Why So Many Process Plants Standardize on Masoneilan Control Valves

Many process control systems — in chemical, paper, petroleum, petrochemical, textile and other plants — use Masoneilan Control Valves exclusively because experience has proved that Masoneilan valves are accurate and dependable. And because they give this top performance over long periods, they are most economical.

The wide variety of applications pictured here are in one modern petroleum refinery which uses Masoneilan valves. There are Masoneilan types for practically all control systems in all other processing plants, too. If you are concerned with the selection of control valves, it will pay you to consider Masoneilan.

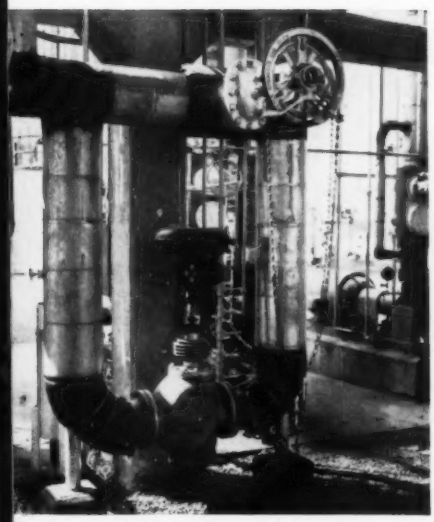
Complete details on control valves for every process use are yours for the asking. Write for catalog.

MASON-NEILAN

A Division of Worthington Corporation

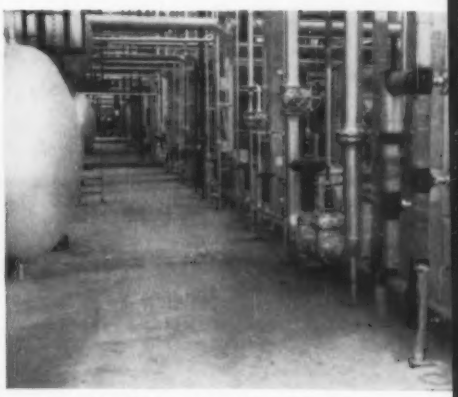
51 NAHATAN STREET, NORWOOD, MASSACHUSETTS

District offices or Distributors in principal cities in U.S.
In Canada: Mason-Neilan, Division of Worthington (Canada), Ltd.



Feed to Storage in Cat Cracker

Effluent Control in Cat Cracker



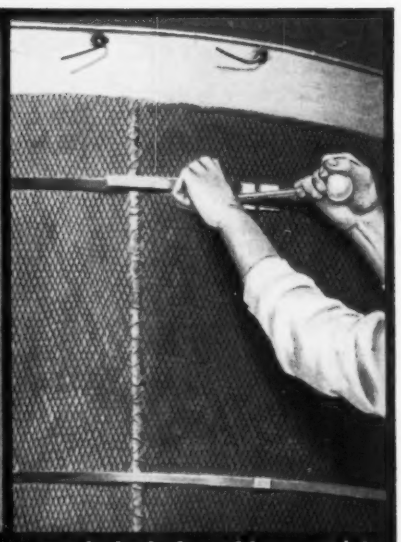
View of Cat Reformer using Many M-N Valves

FACTORY FABRICATED TO RIGID SPECIFICATIONS!

EAGLE-PICHER BLANKET INSULATION

Ready for installation!

Easily conforms to surfaces!



Finished job, free of large voids!

- Copper bearing steel laths, bound by uniformly spaced soft-drawn galvanized tie wires, keep blankets firm but flexible.
- Eagle-Picher mineral wool evenly dispersed over entire insulating area of each blanket.
- Completely free of large voids usually found in field-made blankets where insulation is simply packed in place.
- Smooth edges butted tightly together eliminate cracks and loose joints.
- Quickly applied to flat or slightly curved surfaces of any large equipment—or cut to fit irregular areas.
- Maximum thermal efficiency at temperatures as high as 1200 F.

Eagle-Picher produces a complete line of industrial insulations for all temperatures from below Zero to over 2000 F.

FREE SAMPLE!

Write today!

Eagle-Picher Blanket Insulation conforms to Commercial Standard CS-117-49.

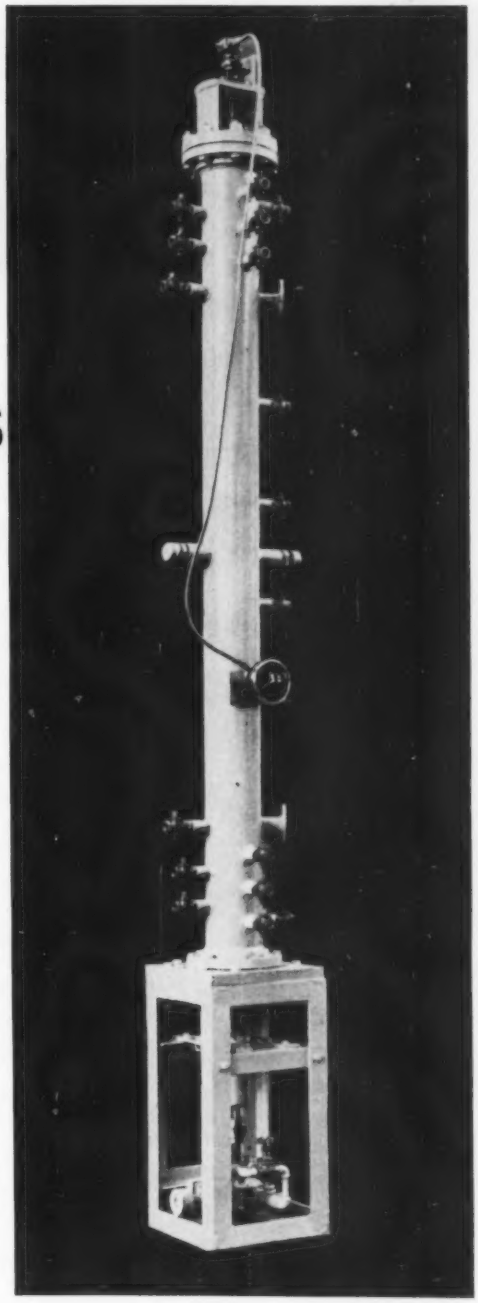
Since 1843

EAGLE-PICHER

The Eagle-Picher Company • General Offices: Cincinnati 1, Ohio

(Member of Industrial Mineral Fiber Institute)

this PILOT SIZE RDC COLUMN helps you solve liquid extraction problems at low cost



Pilot data is usually required to supplement book knowledge in designing for a new liquid extraction problem. Every operation involves variations of recognized techniques that should be known *before* you begin full-scale operations.

General American is ideally equipped to help you pinpoint your requirements in advance by means of pilot-size Turbo-Mixer RDC columns.

Benzene, furfural and a variety of organic solvent extractions have been successfully piloted for commercial design.

Pilot columns are made in diameters from 2 to 6 inches, and lengths up to 8 feet. They may be purchased or leased with rentals applying to cost of production equipment; or you may ask our engineers to study your requirements in our laboratories and design and build full-scale equipment you require.

You may also obtain pilot-size Louisville dryers and Turbo bench-scale and small pilot mixers.

Most important, you have the knowledge of General American engineers, gained from years of experience with the widest variety of problems in liquid and gaseous extraction. Call or write for consultation. You'll find . . .

IT PAYS TO PLAN WITH GENERAL AMERICAN

FOR DETAILED INFORMATION AND USEFUL DESIGN DATA, SEND FOR THE FOLLOWING BULLETINS:

Please send me the following Turbo-Mixer Bulletin (s) :

General Turbo-Mixer Bulletin_____

RDC Extraction Column Bulletin_____

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Process Equipment Division

TURBO-MIXERS

GENERAL AMERICAN TRANSPORTATION CORPORATION

135 South LaSalle Street

Chicago 90, Illinois • Offices in principal cities

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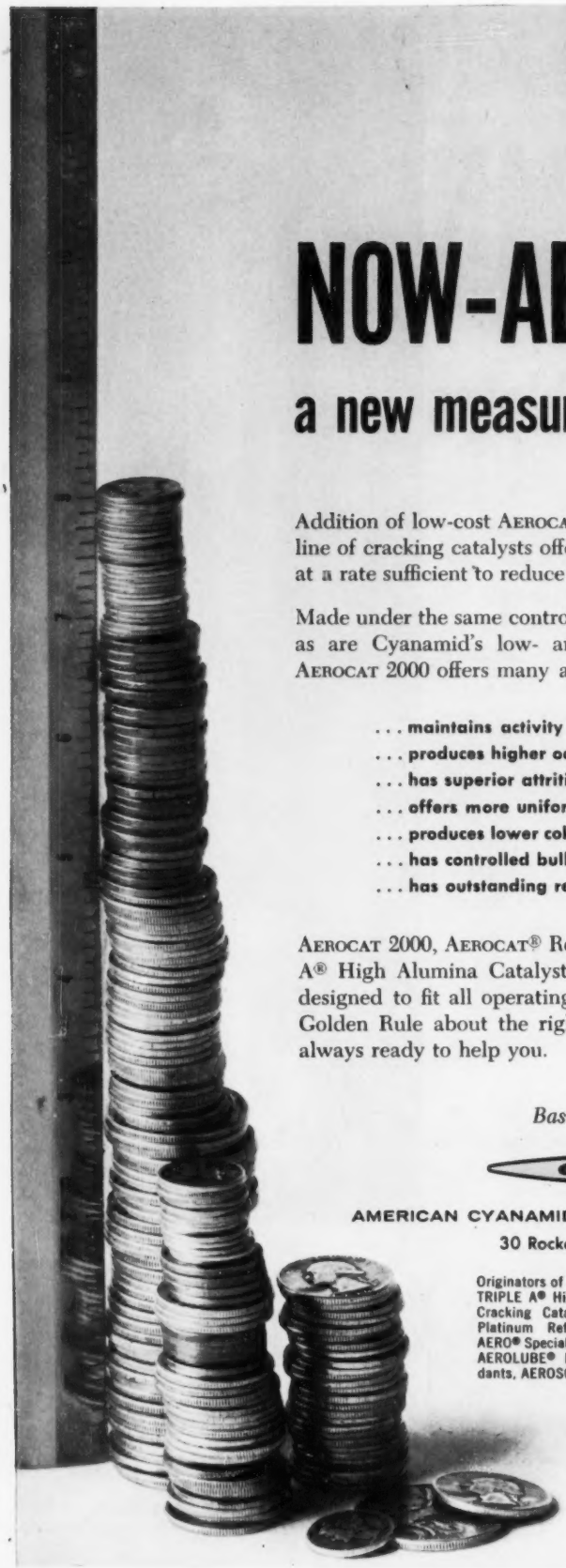


NOW-AEROCAT® 2000

a new measure of catalyst economy

Addition of low-cost AEROCAT® 2000 Fluid Cracking Catalyst to Cyanamid's line of cracking catalysts offers refiners new economy where catalyst is used at a rate sufficient to reduce the effect of heavy metals.

Made under the same controlled conditions, by the same advanced processes as are Cyanamid's low- and high-alumina synthetic cracking catalysts, AEROCAT 2000 offers many advantages over other low-cost catalysts:

- **. . . maintains activity stability with greater economy**
- **. . . produces higher octanes**
- **. . . has superior attrition resistance**
- **. . . offers more uniform physical and catalytic properties**
- **. . . produces lower coke**
- **. . . has controlled bulk density for better fluidization**
- **. . . has outstanding regeneration properties**

AEROCAT 2000, AEROCAT® Regular Fluid Cracking Catalyst, AEROCAT TRIPLE A® High Alumina Catalyst – a complete line of high efficiency products designed to fit all operating conditions. Talk to Cyanamid's Man with the Golden Rule about the right AEROCAT Catalyst for *your* operation. He is always ready to help you.

Basic in Catalyst Chemistry

CYANAMID

AMERICAN CYANAMID COMPANY • REFINERY CHEMICALS DEPARTMENT

30 Rockefeller Plaza, New York 20, N. Y.

Originators of AEROCAT® Fluid Cracking Catalysts, AEROCAT TRIPLE A® High Alumina Catalysts, AEROCAT® 2000 Fluid Cracking Catalyst, AEROFORM® Fluid Hydroforming and Platinum Reforming Catalysts, AERO® HDS Catalysts, AERO® Specialty Catalysts, CYPAN® Drilling Mud Conditioner, AEROLUBE® Lubricating Oil Additives, AERONOX® Antioxidants, AEROSOL® Surface Active Agents.

So many ways the ***FISHER/MAN***
can give you a helping hand with the

WIZARD II
PRESSURE CONTROLLERS

- Two Position Controller
- Proportional Controller
- Proportional Controller —Remote Set
- Differential Proportional Controller
- Pressure Transmitter
- Differential Proportional Controller— Remote Set
- Proportional Reset Controller
- Differential Proportional Reset

This "Jack of ALL Trades" is surprisingly low in cost

The partial list of applications at left tells you why the Wizard II is so aptly named. Probably no other controller in the Fisher line is as versatile. Available in brass, steel or stainless steel Bourdon tubes for ranges from 25 to 10,000 psi. Brass or stainless steel bellows available for low pressure service from 30″ Hg Vacuum to 30 psi.

Fisher has carefully designed each component of the new Wizard to satisfy the most rigid process control requirements. A completely descriptive and illustrated booklet on the Wizard II is yours for the asking. Write for Bulletin D 4150 A.

IF IT FLOWS THROUGH PIPE ANYWHERE IN THE WORLD...CHANCES ARE IT'S CONTROLLED BY...

FISHER GOVERNOR COMPANY

Marshalltown, Iowa / Woodstock, Ontario / London, England

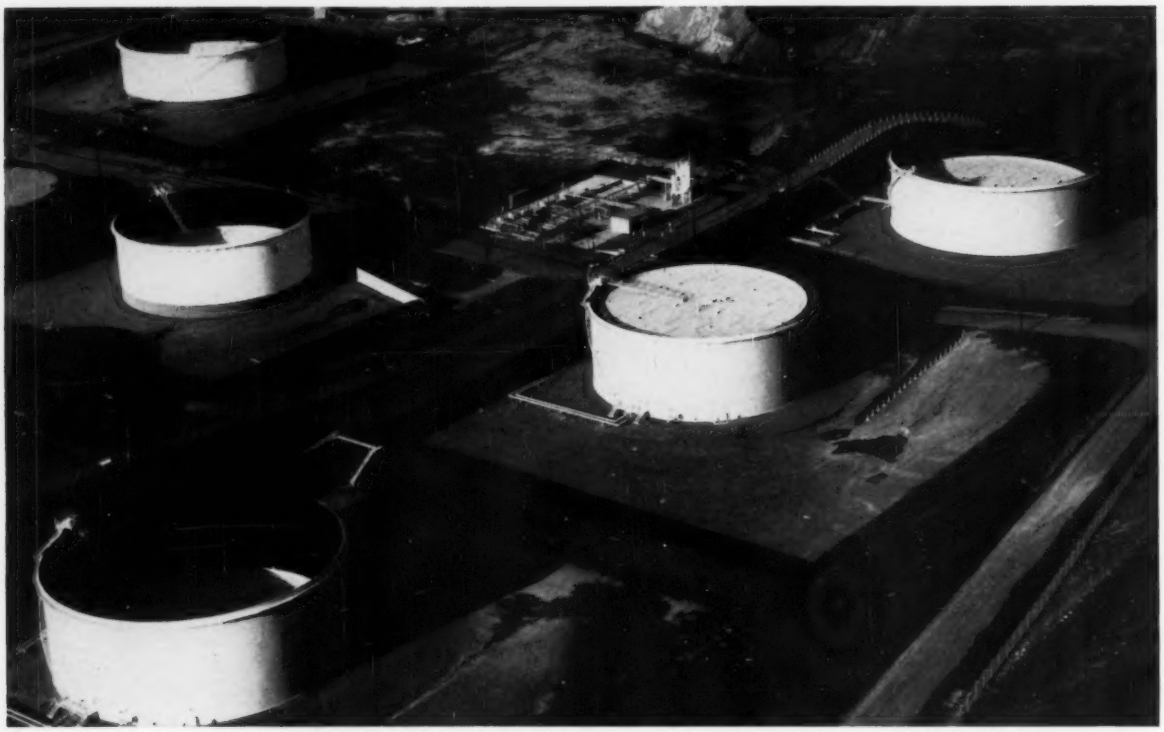
CONTINENTAL EQUIPMENT CO. DIVISION, Coraopolis, Pennsylvania

FISHER® Controls

SINCE 1880

For more data on advertised products, use Readers' Service Cards, last page.

• *Famous Southwest Double-Deck Floating Roof Tanks*



Six of ten large Floating Roof Tanks, built and erected by *Southwest* for Union Oil Company of California, Oleum Refinery

A New Yuba Division with a Long Record of Service to the Petroleum Industry

Southwest Welding & Manufacturing, now a Division of Yuba Consolidated Industries, Inc., has long enjoyed a solid reputation as one of the leading fabricators of heavy products constructed of stainless, alloy, alloy clad, carbon steels, aluminum, everdur, and other special materials.

Such products as Double-Deck Floating Roof Tanks, in use by many leading refineries in California, will be designed by the experienced Southwest engineering staff, and will also be manufactured and sold through the facilities of other Yuba divisions throughout the country. Joining with Southwest and these major Yuba heavy manufacturing operations is Yuba Consolidated Erectors, Inc. – providing a coordinated and integrated service nationwide, from design through fabrication to erection for all industry.

For further information on Double-Deck Floating Roof Tanks and many related products for the petroleum industry, contact *Southwest Welding & Manufacturing Division*, or the Yuba Division nearest you: *Yuba Heat Transfer Division, Honesdale, Pa., Adsco Division, Buffalo, N.Y., Yuba Manufacturing Division, Benicia, Calif., Yuba Consolidated Erectors, Inc., San Francisco, Calif.*

Other Products Produced by Southwest for the Petroleum Industry

Columns (various types)
Reactors
Regenerators
Vacuum towers
Catalytic reforming units
High pressure vessels
Kilns
Retorts
"Dewar-type" vessels

SOUTHWEST WELDING & MANUFACTURING DIVISION

3201 West Mission Road, Alhambra, Calif.

YUBA CONSOLIDATED INDUSTRIES, INC.

Plants and Sales Offices

NATIONWIDE

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is your PROCESS FLOW CORROSIVE?

Honeywell control valves are available in a wide range of materials

Whether you're talking about corrosive or non-corrosive fluids, there's a Honeywell automatic control valve for your particular process flow. It is available in any castable body material and trim material such as . . . stainless steels, Hastelloy, Monel and Durimet 20. This variety of materials permits economical construction to fit your corrosive process flow application.

For corrosive or non-corrosive flows . . . or other process flow conditions . . . Honeywell valves are available in a wide range of types and sizes. When you need control valves . . . contact your local Honeywell field engineer. Write for new Catalog C800-1.

MINNEAPOLIS-HONEYWELL, Fort Washington, Pa.

Honeywell

H HONEYWELL *First in Control*

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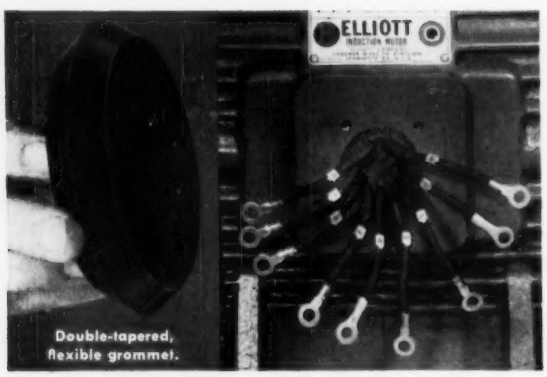
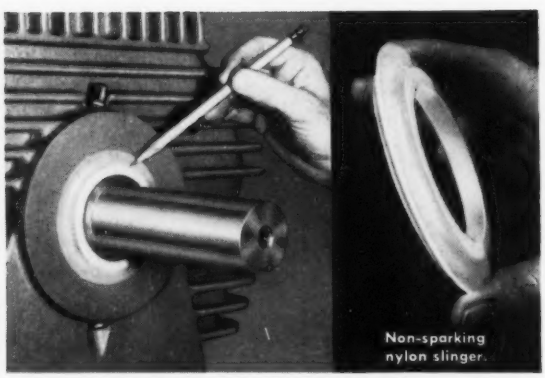
better protection and better cooling make Elliott C-W SEALEDPOWER MOTORS outstandingly



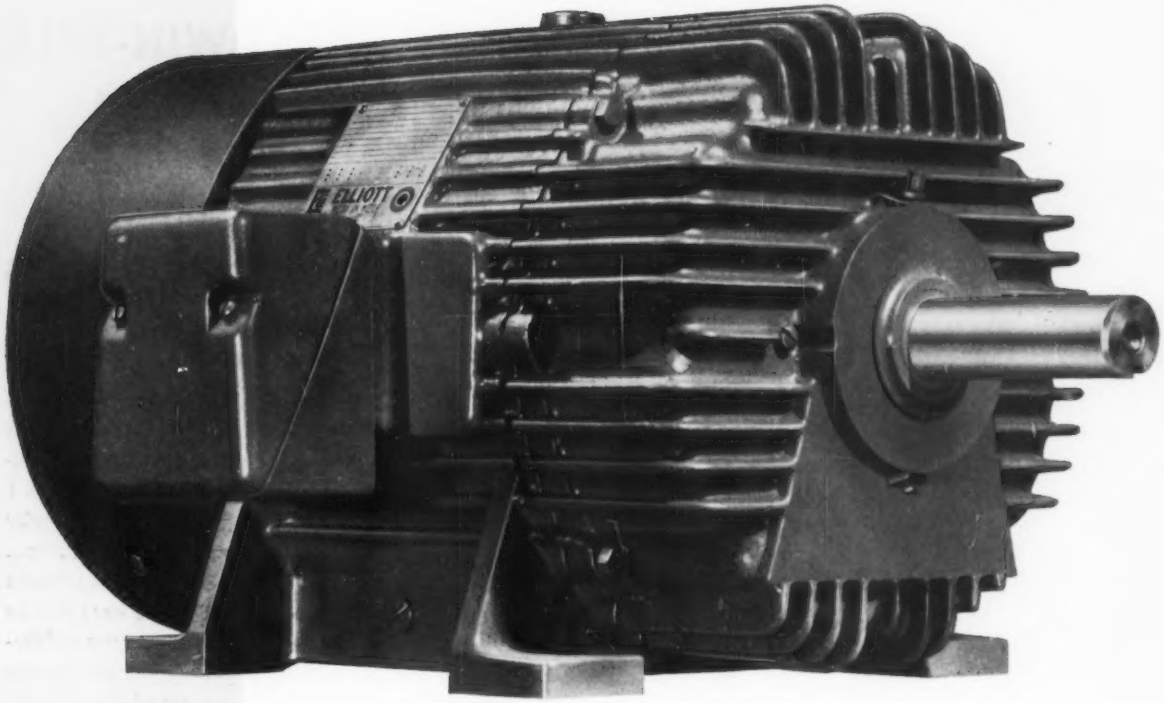
TIGHTLY COMPRESSED GROMMET seals leads where they leave motor frame. Grommet is compressed around numbered leads by pressure ring. No leakage here.



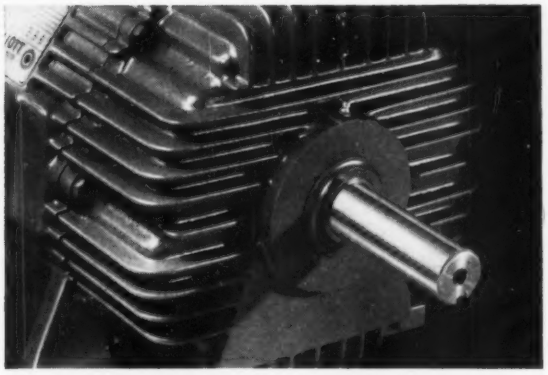
ROTATING SLINGER BANISHES MOISTURE, DIRT that otherwise might creep along shaft and through bearing. Recessed into bracket, it provides long labyrinth-type seal.

IMPORTANT FACTS
about enclosed motors are given in new Elliott Bulletin PB-6000-2. Send for free copy today.

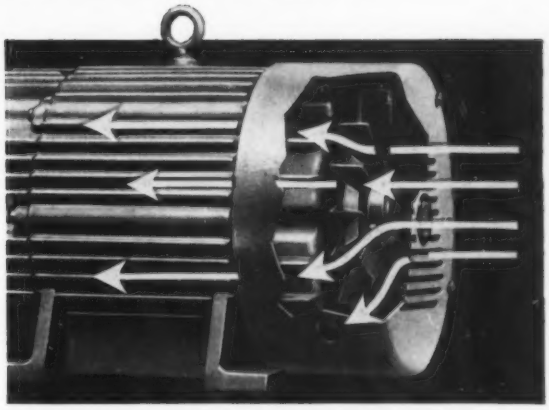
Elliott C-W ribbed-frame enclosed motors, pioneered in the United States by Crocker-Wheeler, include ratings up to 300 hp.



dependable!



MORE AND DEEPER HEAT-RADIATING FINS have greater cooling area. Generous fins over rear bracket keep bearing cool. Non-clogging, easy to clean.



COOLING AIR BLAST FROM EXTERNAL FAN, directed by fan cowl, hugs entire length of motor. Non-sparking fan has keyed and clamped split hub.

ELLIOTT Company

CROCKER-WHEELER PLANT • JEANNETTE, PA.

W9-1

Mold a Heat-Saving Overcoat on Hard-to-Fit Shapes with ...BALDWIN-HILL

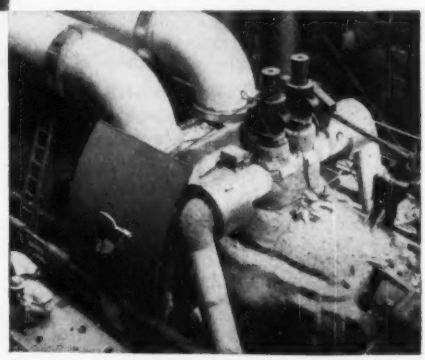
No. 1 INSULATING CEMENT

On such complicated shapes as this steam turbine shell and its exhaust piping at Philadelphia Electric Company's Schuylkill Station, B-H No. 1 Insulating Cement was applied easily and quickly to the irregular surfaces.

Because No. 1 Cement is effective to 1800° F, applicators were able to apply the proper thicknesses of insulation to compensate for the varying surface temperatures of the different zones of the turbine. For instance, on the high pressure shell, 10" of cement was applied on the hottest (1050° F) and 7½" on the coolest (800° F) sections.

An added advantage, for maintenance purposes, is that No. 1 may be removed from equipment where temperatures have not exceeded 1200° F and reapplied elsewhere. And a rust inhibitor prevents any corrosion of metal under the cement.

For more information on B-H No. 1 Insulating Cement and other B-H Insulations, write for Catalog or see it in Sweet's Plant Engineering File.



BALDWIN-HILL *Company*

BALDWIN HILL BH INSULATIONS

CONTRACT APPLICATION SERVICE AVAILABLE

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For more data on advertised products, use Readers' Service Cards, last page.

WmSON

SANDWICH

TAPPING VALVE

U. S. PAT. PENDING

A NEW MEMBER OF A WINNING TEAM!

Designed specifically for temporary use with WmSON Stopple Plugging Machines, Tapping Machines and Lock-O-Ring fittings, the Sandwich Tapping Valve completes the team of WmSON equipment used for tapping and plugging in order to repair or make additions to pipelines or piping without shutdown. Now, after extensive testing in both laboratory and field, the revolutionary Sandwich Tapping Valve is your answer to faster, easier, more economical tapping and stopple work. Faster and easier because it's smaller . . . lighter. Sandwich valves average ¼ as long (face to face) as standard valves . . . allow tapping and plugging in tight places where other equipment is difficult or impossible to use.

NEW! NEW! NEW!

And designed specifically for hot tapping

Plus these outstanding design features

- OVERSIZED BORE
- POSITIVE SHUTOFF
- BYPASS CONNECTION ON EACH VALVE
- INTEGRAL FLANGE STUDS

(Available in 600# series, sizes 4" and larger. Various sizes available for rental.)

For additional information write for Bulletin A-477

T.D. Williamson, Inc.

P. O. BOX 40 TULSA 2, OKLAHOMA

REPRESENTATIVES: HOUSTON • AMARILLO • PITTSBURGH • JOLIET, ILL. • LONG BEACH • SAN FRANCISCO • BARTLESVILLE, OKLA. • SEATTLE • SALT LAKE CITY • WEST MONROE, LA. • EDMONTON • TORONTO • VANCOUVER • BUENOS AIRES • MONTERREY AND MEXICO CITY • CABIMAS, ZULIA, VENEZUELA • DURBAN, NATAL, SOUTH AFRICA • PARIS • SYDNEY, AUSTRALIA • ROME, ITALY • MADRID, SPAIN • FRANKFURT/MAIN, GERMANY

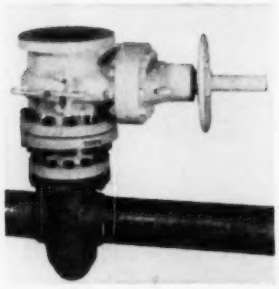
For more data on advertised products, use Readers' Service Cards, last page.

repair, replace and install equipment
repair leaks
tie-in lines and loops

SAFELY *under pressure!*

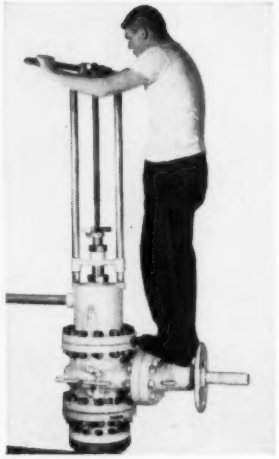
All of these operations are done quickly and economically by isolating a section of line with **MUELLER**® Line Stopper Fittings and Equipment. ■ Shown below is the simple step-by-step method developed by Mueller Co. to get fast, effective stop-offs in any line. By making two pressure stop-offs at once and using a by-pass line, a section of line can be completely isolated without interrupting the flow of fluid. ■ A by-pass connection, built into the body of each stopping machine, makes it easy to install a temporary by-pass line with a minimum investment in time and materials. This detail of design is typical of the attention to detail in research, design and engineering that becomes a part of every Mueller product. ■ Mueller Line Stopper Fittings and Equipment may be used on lines up to 12″ in size, under various pressures as high as 500 p.s.i. on most models and temperatures to 250° F. Write for complete information.

MUELLER NO-BLO® Method

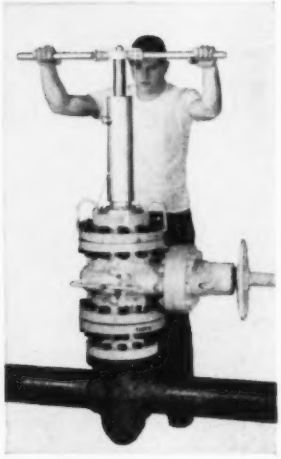


Step 1. Weld fittings to line. Bolt gate valves to fittings.

Step 2. Bolt Mueller Drilling Machine to valve. Cut-out sections of line to accomodate stopper. Remove drilling machine.



Step 3. Bolt stopping machines to valves. Connect by-pass. Stop-off line. Section of line now isolated—ready for repair, replacement or tie-in.



Step 4. Remove stopping machines and by-pass. Install completion plug in top of fitting with completion machine.

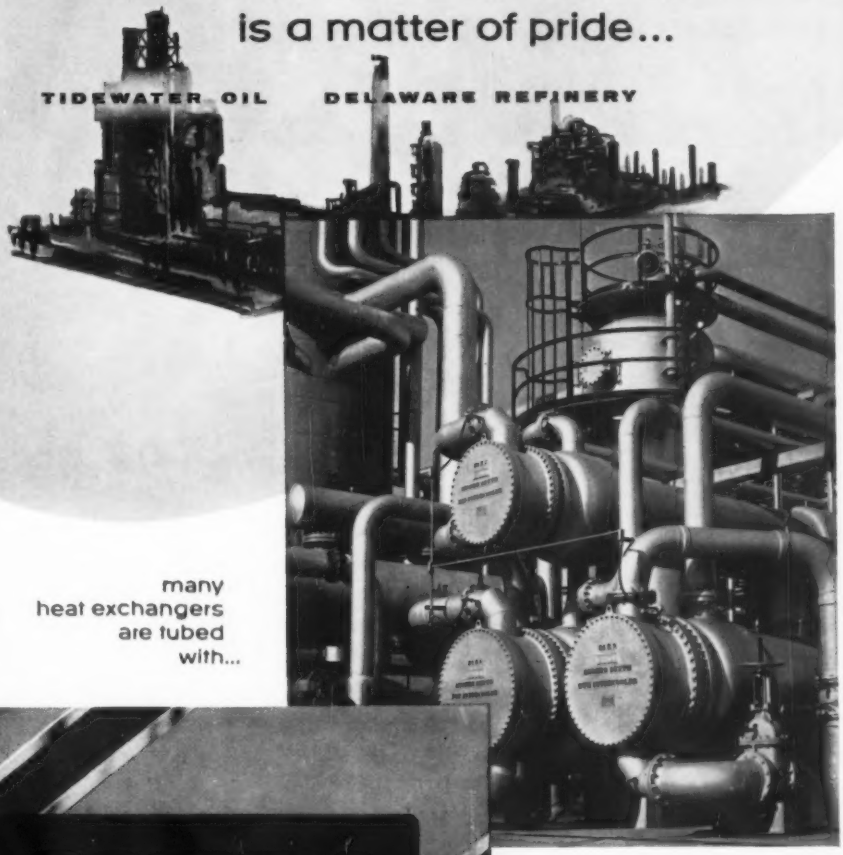
Step 5. Remove all equipment. Cap fittings.

MUELLER CO.
DECATUR, ILL.

Factories at: Decatur, Chattanooga, Los Angeles; In Canada: Mueller, Limited, Sarnia, Ontario.

where trouble-free performance is a matter of pride...

TIDEWATER OIL DELAWARE REFINERY



"the refinery of the future"

many heat exchangers are tubed with...

SCOVILL

HEAT EXCHANGER TUBE

Tidewater Oil Company's showplace installation in DELAWARE, first in a new generation of oil refineries and the largest ever built at one time, also features some of today's finest examples of modern heat exchanger equipment.

The plant was engineered and designed by Tidewater and C. F. Braun & Co., who were also the builders. Selection of Scovill Cupro-Nickel, 30% Heat Exchanger Tube was based on a well-proved formula for trouble-free heat exchanger performance . . . Scovill craftsmanship in tube production plus Scovill Technical Services.

If you are designing, building or operating heat exchangers, it will pay you to discuss trouble-free performance with Scovill.

HEAT EXCHANGER TUBE for Applications from Marine to Petrochemical, from Compressor Intercoolers to "Cat-Cracker" Exchangers, in these popular Alloys . . .
Phosphorized Admiralty • Admiralty • Arsenical Admiralty • Red Brass, 85% • Deoxidized Copper • Arsenical Copper • Cupro-Nickel 10%-20%-30% • Aluminum Brass • Aluminum Bronze, 5% • Muntz Metal • Duplex Tube

MADE IN U.S.A. TO THE STANDARDS OF AMERICAN INDUSTRY

Scovill Manufacturing Company, Mill Products Division, 99 Mill Street, Waterbury 20, Connecticut. Phone Plaza 4-1171.

SDCM

Tuffy Tips —on safe use of Slings and Hoist Lines

Professional Weight Lifters Work the Safety Angles

Here's a tip that could save an injury and absenteeism. The weight lifter's secret is proper leverage. Plus use of major leg muscles instead of back muscles. The weight lifter never leans over to pick up the load. He squats down as near as possible to it, and keeps his back erect all the time. Lifting action comes from legs and thighs. If you must use muscle for some of the lighter lifting jobs, these points are worth remembering. But wherever possible—and always for heavy loads—use hoists and slings.

How to Play It Safe When Loading Slings and Hoist Lines

1. **Keep pull** on sling legs in a straight line. Never shorten legs with knots or I-bolts. If choker and basket hitches are used on slings, check rated load limits.

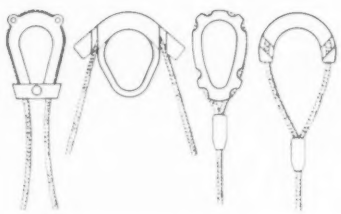
2. **Load slings** on the center of hooks. Never at their points, except for hooks specially designed for point loading.

3. **Never use** load hooks that are bent open. They have been overloaded, and may drop loads with disastrous results. Same goes for defective chain blocks. Insist that your men report them at once.

4. **Lubricate wire ropes** at regular recommended intervals, with lubricant recommended by your local oil company engineer.

Proper Fittings Can Give Slings Added Safety and Service Life

The sling eye is usually the point of greatest wear in load handling. The proper sling fitting acts as a shield to take the brunt of this wear—the load shocks, abrasion and other stresses concentrated in the eye. Shown here are some of the Tuffy fittings you can have factory-installed in your Tuffy Slings, or they can be installed in your own rigging loft. Left to right: (1) **Equalizing Thimble** permits adjustment of the length of sling legs so that loads of varying dimensions may be picked up and handled on an even keel. (2) **Newco Sling Bridle** will not slip when handling unbalanced loads. (3) **Newco Slip-Thru Thimble** allows passage of an identical thimble through its eye—necessary when a regular sling is used as a choker sling. (4) **Newco Slip-On Thimble** eliminates flattening or pulling together of eyes under heavy loads; can be attached or removed in seconds.



Tuffy Sling Stamina is Matched in Tuffy Hoist Line

Tuffy Hoist Line is a special rope construction for use on all types of overhead cranes, derricks and clamshells. Like all Tuffy Special Purpose Ropes, it has the right combination of strength, flexibility and toughness for greatest safety and longest life in its specific range of uses. Tuffy Slings and Hoist Line make a team that cuts hoisting costs and downtime in every type of materials handling.

Your Tuffy Distributor Offers the Most in Service and Savings

Tuffy Braided Wire Fabric: Successor to Wire Rope in Slings

The unique machine-braided construction of Tuffy Slings provides a combination of "free flowing" flexibility and toughness never possible with ordinary wire rope. The difference is in the patented 9-part fabric, braided by precision machines in a process that eliminates inequalities of hand-braiding.

Kinks Are No Hazard with Tuffy Slings

One of the first rules of safety: never use a wire rope sling that has been kinked. The wires are permanently bent, damaged or weakened. Not so with Tuffy Slings. Tuffy's patented, 9-part machine braided fabric is just about impossible to kink. And if it does, under some unusual condition, you can straighten out the kink, leaving no material damage.

Tucked Eye Splices— Gripped in Steel for Strength and Safety

This Tuffy ferrule, slipped over the tuck-splice of the eye and pressed on under tremendous hydraulic pressure, holds so tight that it gives the eye splice 100% of fabric strength. The ferrule itself is smoothly tapered to meet the main body of the sling. No abrupt edges or rough projections to injure hands and slow down work. The extra life, efficiency and safety of Tuffy's pressed-on ferrule is yours at no extra cost!

FREE! New Tuffy Sling Handbook

Revised and enlarged edition of this famous sling manual. Covers slings from A to Z. Types, dimensions, weights, rated loads, fittings. Even includes safety-approved standard signals used in operation of various equipment. Send for your free copy now. Union Wire Rope Corporation. Specialists in high carbon wire, wire rope, braided wire fabric and stress relieved wire and strand. 2284 Manchester Ave., Kansas City 26, Mo.

S2

UNION Wire Rope

ARMCO

Subsidiary of ARMCO STEEL CORPORATION

OTHER SUBSIDIARIES AND DIVISIONS: Armco Division • Sheffield Division • The National Supply Company
Armco Drainage & Metal Products, Inc. • The Armco International Corporation • Southwest Steel Products

For more data on advertised products, use Readers' Service Cards, last page.

Why Insul-Mastic costs less than ordinary asphalt coatings . . .

THERE are several ways to measure the cost of a protective coating. But the only *true* way is by measuring its *performance*. And performance is determined largely by the materials that go into a coating.

Insul-Mastic is sometimes considered an asphalt-type coating. But, unlike ordinary asphalt coatings, Insul-Mastic contains special materials which resist corrosion and wear far longer and better than straight asphalt coatings.

These materials include:

1. ***Large Amounts of Gilsonite*—the natural resin that is virtually *unaffected* by moisture, acids and alkalis.**
2. ***Mica Flakes*—highly resistant to weather, wear and sun's rays.**
3. ***Asbestos Fibers*—used as binders to provide greater toughness and resistance to wear.**

Obviously, Insul-Mastic costs a few cents more than common asphalt coatings. But, when you measure its cost in terms of *far greater service life* (10 to 20 years is not uncommon), Insul-Mastic *always* proves to be your most economical investment!

Still another important Insul-Mastic *plus* is the technical field service which is available whenever you need application assistance. *Call your Pitt Chem Distributor for full information about Insul-Mastic coatings, today!*

Think First of the Coatings that Last!

PITT CHEM "Insul-Mastic"® Gilsonite-Asphalt Coatings

PITT CHEM "Tarmastic"® Coal Tar Coatings

PITT CHEM "Tarset"® Coal Tar-Epoxy Resin Coatings

PITT CHEM Industrial Coatings are available through leading Industrial Distributors. See the "Yellow Pages."

PROTECTIVE COATINGS DIVISION
PITTSBURGH COKE & CHEMICAL CO.
Grant Building • Pittsburgh 19, Pa.

WBW-7438

PROTECTIVE COATINGS • COAL CHEMICALS • PLASTICIZERS • ACTIVATED CARBON • CEMENT • COKE • PIG IRON • FERROMANGANESE

For more data on advertised products, use Readers' Service Cards, last page.

. . . BECAUSE quality counts in the long run

1. Seamless and weldless construction.
2. Made from new, full weight material.
3. Uniform length and shape.
4. Accurate threads—beveled for easy starting.
5. Square faced ends.
6. Chamfered inside edges.
7. Ample tong space.
8. Rust-Proof ZINCOTING, for threads and body, inside and out.
9. Attractive labeling for size, thread and weight.
10. Color coded for easy thread identification.
11. Packaged for shipping and storing.

LARKIN FORGED STEEL FITTINGS ARE RECOGNIZED AS THE STANDARD IN THE INDUSTRY

LARKIN PACKER COMPANY, INC.
WAXAHACHIE, TEXAS

LARKIN
...Through Your Supply Store

PESA

LARKIN LEADERSHIP HAS BEEN EARNED BY YEARS OF DEPENDABLE PERFORMANCE

THE MORAL is obvious. It applies not only to the rendition of music but to the prefabrication and erection of critical piping, which most engineers of power and process plants insist on delegating directly to specialists. For your economy, satisfaction and safety . . . ask us in.

W. K. MITCHELL & CO., INC.

Philadelphia 46, Pa.

WESTPORT JOINT
(PATENTED)

MITCHELL PIPING
SINCE 1899

PIPING FABRICATORS AND CONTRACTORS

For more data on advertised products, use Readers' Service Cards, last page.

Bingham STUFFINGBOXLESS PUMPS

HANDLE AT HIGH

FIREPROOF AND EXPLOSION-PROOF! Leakage of vapor or liquid to atmosphere or leakage from outside into pump is *impossible*. Not only is plant and personnel protected but loss of valuable pumpage is prevented. Type KC High-Pressure Single-Stage Stuffingboxless Pump illustrated.

NO STUFFING BOX! NO PACKING!

Bingham Stuffingboxless Pumps are successfully handling liquids having high vapor pressure, requiring high suction pressure and, frequently, abnormally low pumping temperature (—300° F). Standard models handle suction pressures up to 2,000 psi (higher pressures available). Pumping temperatures to 850° F and higher also can be handled. These conditions present no difficulty for Bingham Stuffingboxless Pumps, but they are difficult and sometimes impossible to meet with conventional pumps due to limitations imposed by the stuffing box.

Because there is *no stuffing box*, Bingham Stuffingboxless Pumps eliminate all the disadvantages of conventional pumps operating with stuffing boxes equipped with packing or mechanical seals.

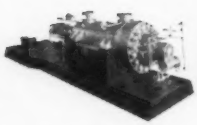
Bingham Stuffingboxless Pumps are in service today all over the world, with distinguished records in reliability, continuity of service, and low maintenance. Write to your nearest Bingham office for Bulletin 107 or for additional information.

***And other volatile liquids.**

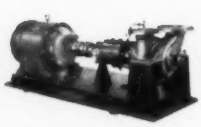
TYPICAL BINGHAM "DOUBLE VOLUTE"

The Bingham Type HPD "Double Volute" Multi-Stage Double Case "Hi-Press" pump for extremely high pressure service.

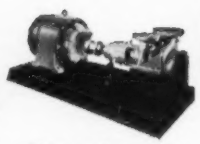
Bingham Type VS Single-Stage Wet-Pit Pump for high capacity, medium head service.



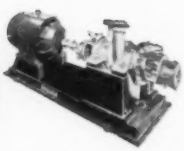
Bingham Type CP "Double Volute" Multi-Stage, Double-Case pump for hot or cold service.



A Bingham Type CKA "Double Volute" Single-Stage Koke-Krusher for coke-laden pumpage.

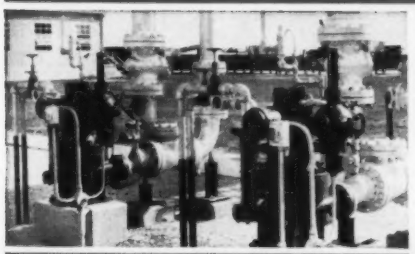


Bingham Type CAD "Double Volute" Single-Stage Process Pump.

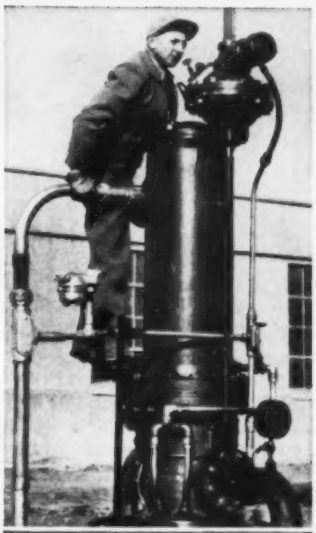


Bingham Type CM vertically split-case two-stage pump for hot service.

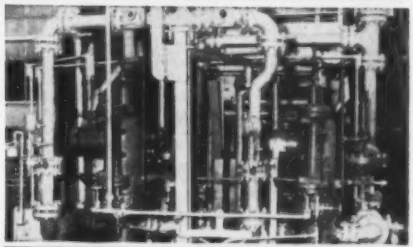
LIGHT HYDROCARBONS* SUCTION PRESSURES



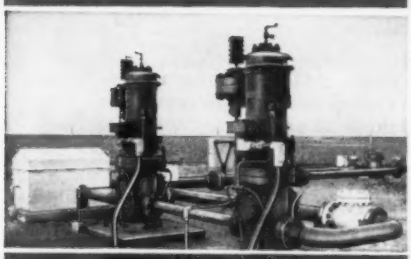
Stanolind Oil & Gas Co., Eunice, N. Mex.



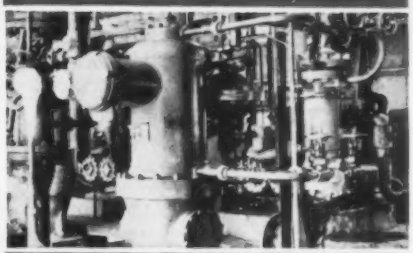
Pump on Wyco Pipeline.



ESSO Standard Oil Co., Bayway, N. J.



a major products pipeline.



Polymer Corp., Sarnia, Ontario, Canada.

Partial List of Refineries Using Bingham Stuffingboxless Pumps

British American Oil Co., Ltd.
Carbide & Carbon Chemical Co.
Canadian Investors, Ltd.
Cities Service Company
Creole Pipe Line Company
E. I. duPont de Nemours & Co.
ESSO Standard Oil Co.
Great Lakes Pipe Line Co.
Gulf Oil Corp.
Imperial Oil Company Ltd.
Polymer Corporation
Phillips Petroleum Co.
Stanolind Oil & Gas Co.
Sinclair Oil Company
Sohio Petroleum Co.
Standard Oil Company of Indiana
Tennessee Gas & Transmission Co.
Tide Water Associated Oil Co.
Texas Company
Warren Petroleum Co.

Bingham SINCE 1921

DOUBLE VOLUTE PUMPS RADIAL BALANCE

BINGHAM PUMP COMPANY
General Offices: **2800 N.W. Front Avenue, Portland 10, Oregon**
Factories: **Portland, Ore. • Vancouver, B. C., Canada**

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SEATTLE, WASH.
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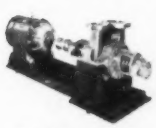
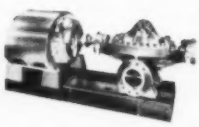
ST. PAUL, MINN.
TULSA, OKLA.
TORONTO, ONT., CAN.
VANCOUVER, B. C., CAN.

PUMPS FOR PETROCHEMICAL SERVICE

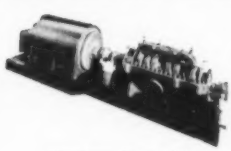


Bingham Type CD "Double Volute" Double Suction vertically-split case pump for hot service.

Bingham Type CJ "Double Volute" Two-Stage Process Pump.



Bingham Type HSB "Double Volute" Double Suction Pump for high heads.

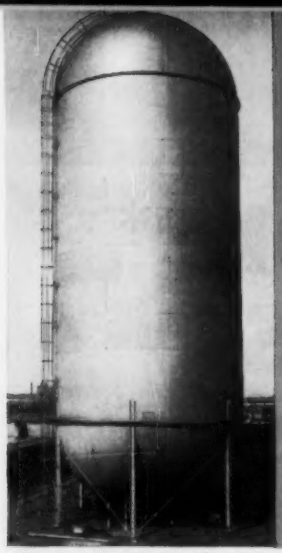


Bingham Type MSB Horizontally Split-Case Multi-Stage Pump for high pressure hot or cold service.

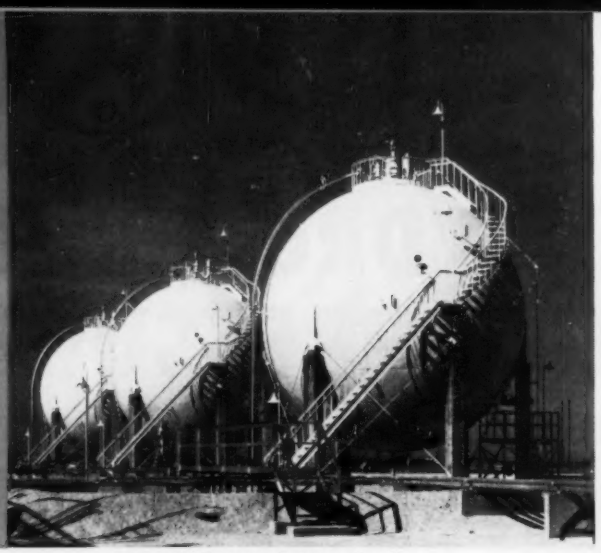
Bingham Type KT Stuffing-boxless Pump for high suction pressures and cold service.

Bingham Type VCP Vertical Pump for low NPSH conditions, featuring bottom dismantling.

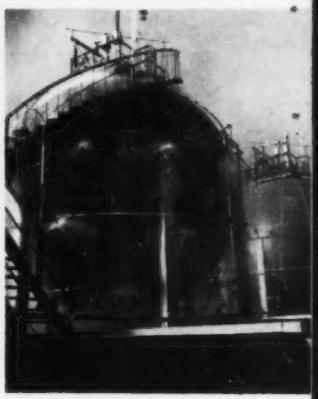
For more data on advertised products, use Readers' Service Cards, last page.



Pressure Gas Holder, 40′ x 69′



30′ Pressure Spheres, Gasoline



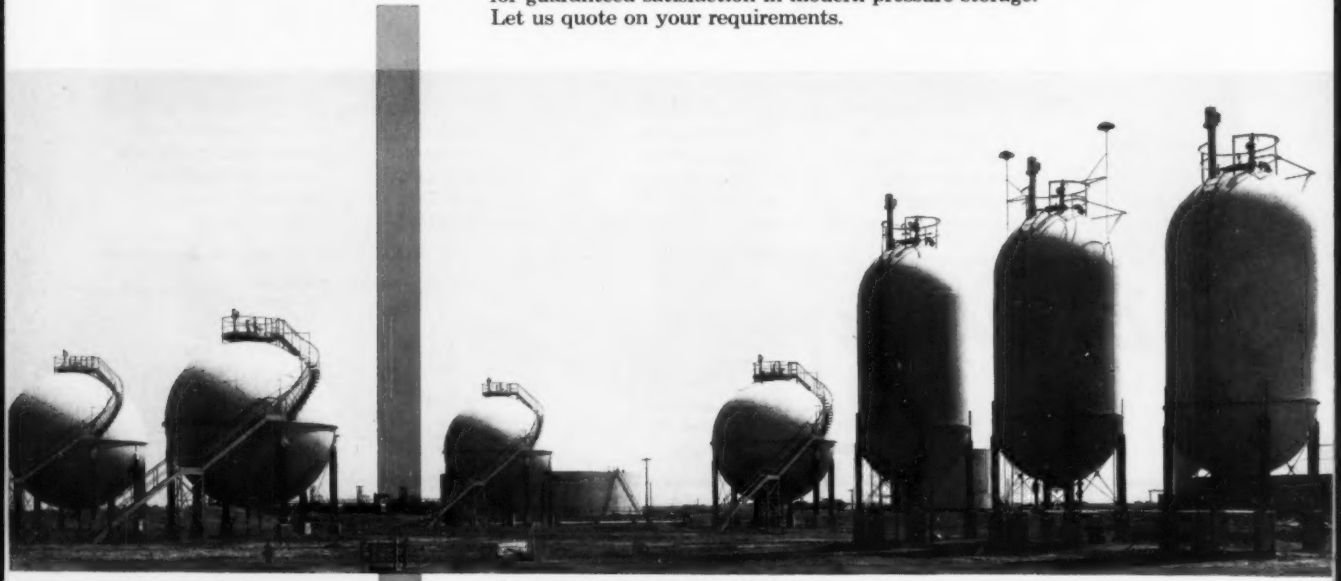
30′ Pressure Spheres, Butadiene

EFFICIENT PRESSURE STORAGE OF VOLATILE PETROLEUM PRODUCTS

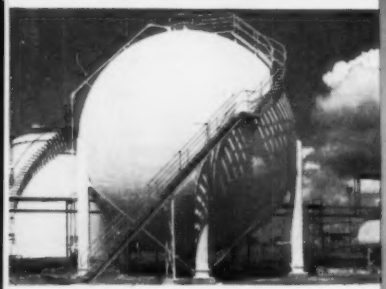
PDM
STEEL PLATE WORK

SPHERES and BULLETS

For gasoline, gases and many petrochemicals, compact Pressure Spheres and Bullets by Pittsburgh-Des Moines offer valuable savings of storage space and prevention of evaporation losses. Efficient design, dependable fabrication and expert erection, complete with all piping, valves and fittings, make PDM your logical choice for guaranteed satisfaction in modern pressure storage. Let us quote on your requirements.



Pressure Spheres and Vertical Bullets



38′ Sphere, 40 psi working pressure

Pittsburgh-Des Moines Steel Company

Plants at PITTSBURGH, BALTIMORE, DES MOINES, SANTA CLARA, FRESNO, and STOCKTON, CALIF.

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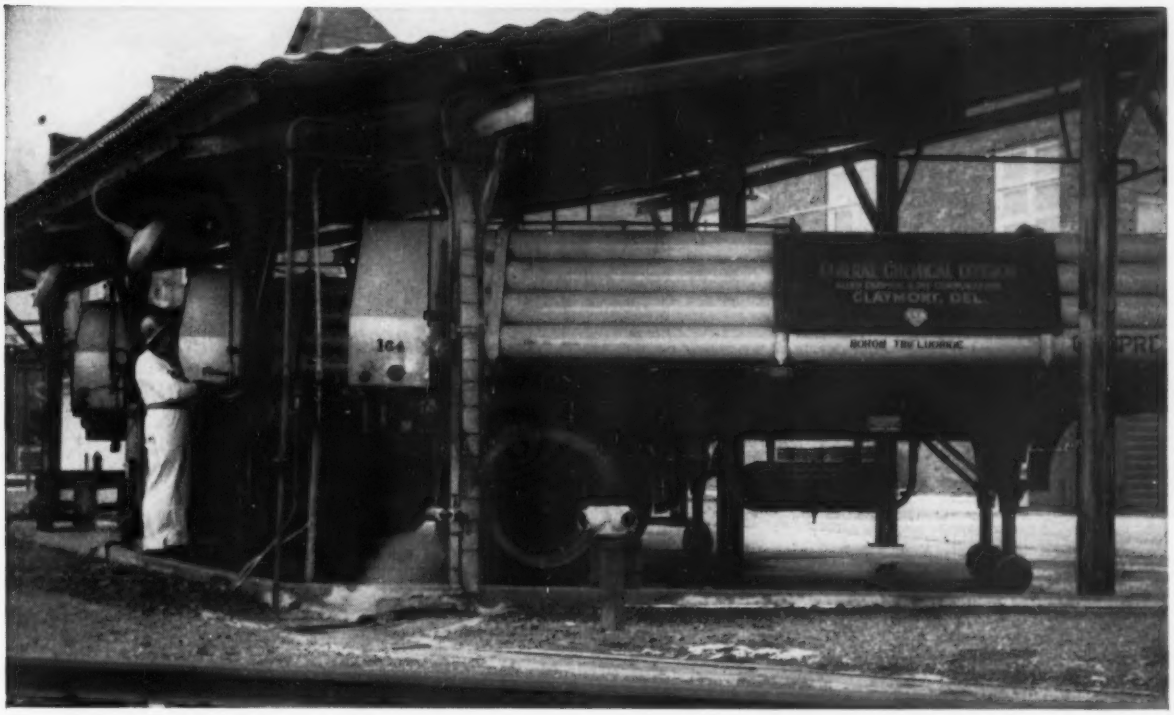
BALTIMORE (26).....Curtis Bay Station
NEW YORK (17).Suite 2763, 200 E. 42d St.
CHICAGO (3), 686 First National Bank Bldg.
ATLANTA (5)..361 E. Paces Ferry Rd., N.E.
DES MOINES (8).....983 Tuttle Street
DALLAS (1).....1287 Praetorian Bldg.
SEATTLE (1).....Suite 390, 500 Wall St.
SANTA CLARA, CAL.....689 Alviso Road
DENVER (2)...323 Railway Exchange Bldg.
EL MONTE, CAL.,.....P. O. Box 2012



How B&A® meets your needs for

BORON TRIFLUORIDE

Gas and Complexes

With large-scale production . . . Baker & Adamson has long been the leader in production of BF_3 gas—shipping this versatile catalyst in large trailer trucks like those you see being loaded above. B&A pioneered this method of shipment and today has a fleet of these trucks always on the road, serving the needs of the process industries.

With reference data . . . Baker & Adamson has compiled a considerable amount of reference data on the applications of Boron Fluoride gas and complexes. Boron Fluoride's wide range of applications and its cost-cutting production advantages—such as its ease of catalyst removal—make it a factor to be considered in almost any organic synthesis problem.

Mail coupon today—for technical data on properties and typical uses of B&A Boron Trifluoride gas or any of the complexes listed below. Attach company letterhead, please.

Boron Fluoride Ether (Diethyl) Complex
Boron Fluoride Phenol Complex
Boron Fluoride Diacetic Acid Complex
Boron Fluoride Di-n-Butyl Ether Complex
Boron Fluoride Dihydrate
Boron Fluoride Ethyl "Cellosolve" Complex
Boron Fluoride Hexamethylenetetramine Complex
Boron Fluoride Monoethylamine Complex
Boron Fluoride Para-cresol Complex
Boron Fluoride Triethanolamine Complex
Boron Fluoride Urea Complex

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☐ Please send general information on properties and uses of Boron Trifluoride gas ☐

_____ complex ☐

☐ Please send information on Boron Trifluoride for the following application:

_____

_____

Name _____

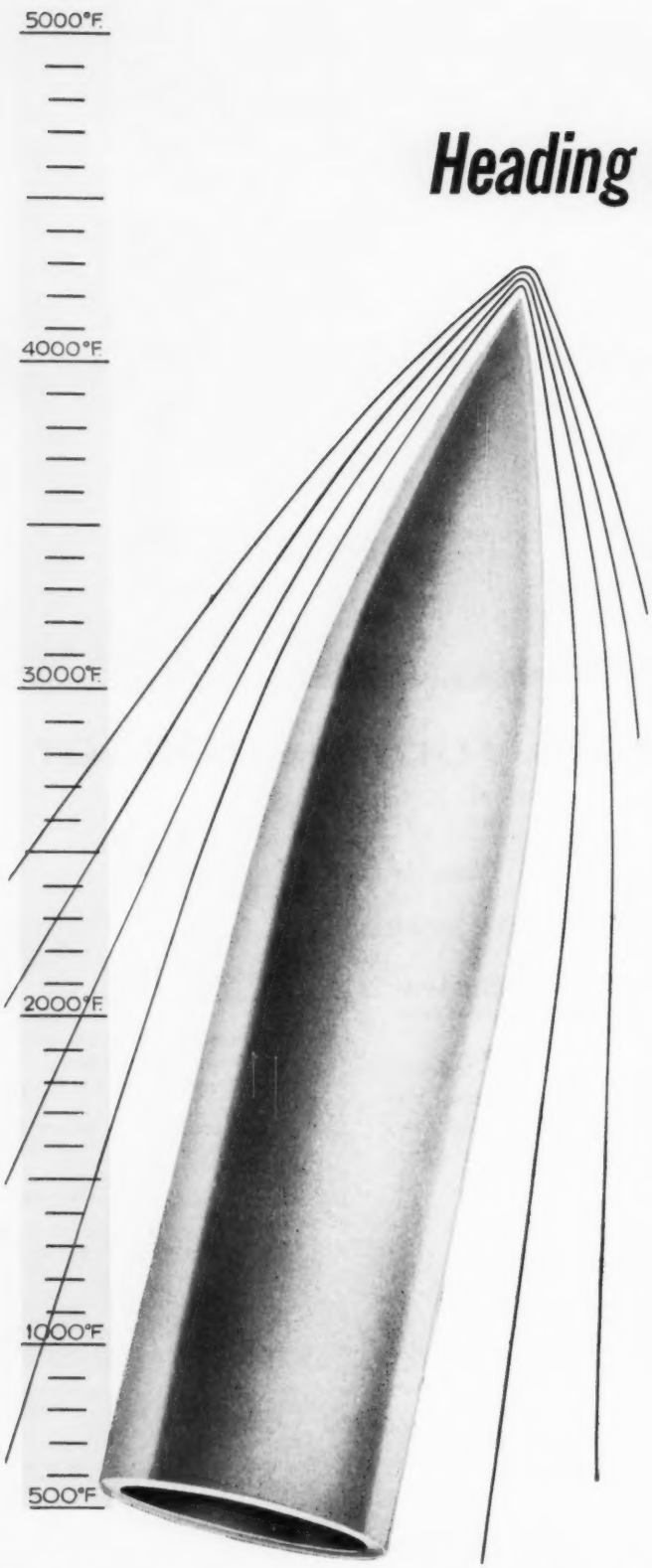
Position _____

Company _____

Address _____

City _____ Zone ____ State _____

For more data on advertised products, use Readers' Service Cards, last page.



Heading for the unknown?

Check your processing requirements against Norton Fused Zirconia

You can't predict tomorrow's processing requirements. However, you can be prepared to meet many of them more efficiently and economically . . . with Norton *Lime-Stabilized* Fused Zirconia.

Consider Its Unusual Characteristics

Extremely high melting point (4,620°F) coupled with a lower thermal conductivity than standard dense refractories • Excellent resistance to thermal shock and abrasion • Not wet by most metals • Moderate electrical insulator at low temperatures and conductor above 2,200°F • Good stability in either oxidizing or reducing atmospheres.

Consider Its Many Applications

As potential material for use in missiles and reaction motors • As a support for firing highly-reactive titanates • As lining for furnaces containing high temperature gaseous reactions • For furnace parts and linings used in the metals industry • As lining and packing media for high temperature air heaters and heat exchangers • For many other critical processes.

Chances are you can improve both your processing and your production economy with this rugged, versatile material. Let a Norton Sales Engineer help. He's well qualified to discuss your precise requirements. Write to NORTON COMPANY, Refractories Division, **462** New Bond Street, Worcester 6, Mass.

Note: Norton *Lime-Free* Fused Zirconia is also available for the manufacture of refractories, as a source material for zirconium for chemicals and metals, or as an opacifier for glazes and enamels.

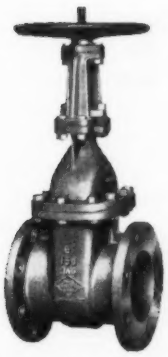
Melting Point	4,620°F
Maximum Usable Temperature	4,450°F
Chemical Nature	Stable
Electrical Resistivity	High Temperature Conductor
True Specific Gravity	5.6 — 5.7
Two Grain Types	Hard Dense Grains Bubble-Type Grains

NORTON
REFRACTORIES
Engineered... Rx ...Prescribed

Making better products . . . to make your products better

NORTON PRODUCTS Abrasives • Grinding Wheels • Grinding Machines • Refractories • Electrochemicals — **BEHR-MANNING DIVISION** Coated Abrasives • Sharpening Stones • Pressure-Sensitive Tapes

For more data on advertised products, use Readers' Service Cards, last page.



In this **Split Wedge Gate**

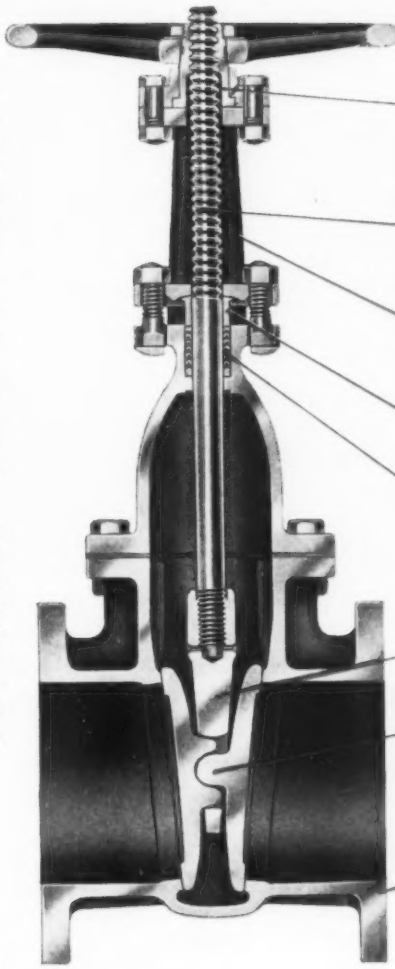
you can see why it pays to

Specify JENKINS for STAINLESS STEEL Valves, too

This picture shows the many points of excellence in the design and construction of Jenkins Fig. 1327 Split Wedge Stainless Steel Gate Valves. Compare them with any valve you know. You'll conclude that it's hard to beat Jenkins at making valves, no matter what the material.

But no picture can show the quality of the castings . . . the precision machining . . . the rigid inspection and testing that have gone into this valve. All of these are as important as design and metal alloys in assuring long, dependable, economical valve service. And, all of them are up to the peak standards for which Jenkins has been known for almost a century.

SEND FOR NEW CATALOG of Jenkins Stainless Steel Valves. You'll find in it the patterns you want, in a choice of alloys that satisfy the requirements of practically all corrosive services. Also, you'll see that these Jenkins valves meet valve industry specifications and the high standards established by the leading users of stainless steel valves. Jenkins Bros., 100 Park Avenue, New York 17.



WHEEL of high strength malleable iron designed for firm grip and easy operation.

YOKE BUSHING, easily renewable. Made of bronze, for ideal thread engagement with stainless steel spindle, to prevent seizing or galling of spindle threads. Bushing of stainless steel is optional.

SPINDLE has long thread bearing surfaces with correct lead for easy, tight closing. Screws into wedge carrier, then secured by a stainless steel pin.

YOKE BONNET has liberal space between yoke arms for easy access to packing box. Precision machined flange face assures uniform contact with gasket for a tight body-bonnet joint.

GLAND consists of two pieces — gland flange and gland follower — eliminates binding of follower in case gland bolts are tightened unevenly.

PACKING of Chevron-type Teflon in large packing box prevents leakage. Only a minimum load is required on gland, extending service life of packing.

WEDGE CARRIER connects wedge to spindle and raises or lowers it. Husky in size to stand any operating strains.

SPLIT WEDGE is the ball-and-socket design which automatically adjusts to the tapered seating surfaces for positive shutoff. The discs, revolving freely in the wedge carrier, produce a self-cleaning action on seating surfaces and reduce possibility of galling and seizing.

BODY —Through-port design for full, free flow. Ample wall thickness and good design provide extra strength to withstand stresses. End flanges conform to M.S.S. specs.

JENKINS VALVES

LOOK FOR THE JENKINS DIAMOND

JENKINS SINCE 1864

Sold Through Leading Distributors Everywhere

JENKINS BROS., 100 Park Avenue, New York 17, N. Y.

☐ Send the new stainless steel valve catalog

☐ Have a representative call on me

NAME & TITLE.....

COMPANY.....

ADDRESS.....

For more data on advertised products, use Readers' Service Cards, last page.

YOU CAN BUY THESE 9 CATALYSTS FROM A SINGLE SOURCE!

Stauffer is a major source of metal chlorides and other catalysts widely used in the Petroleum and Chemical industries. Wide distribution of manufacturing and warehouse facilities assures a continuous, dependable and *flexible* source . . . a *single* source for all these important catalysts.

STAUFFER CHEMICAL COMPANY

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Stauffer CHEMICALS SINCE 1885

ALUMINUM TRICHLORIDE — Various mesh sizes in drums of 50 to 600 pounds net, and in bulk. Also in solution.

ANTIMONY CHLORIDES — Both solid and flake (anhydrous) in drums of 25 to 700 pounds net. Liquid pentachloride in drums of 25 to 700 pounds net, in tank trucks and tank cars.

BORON TRICHLORIDE — In low-pressure cylinders of 100 and 1800 pounds net; also in tank cars. 6-pound cylinders for experimental use.

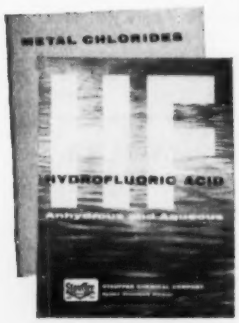
HYDROCHLORIC ACID — Anhydrous HCl available in tube trailers or cylinders from Los Angeles, Calif., and Fort Worth, Texas.

HYDROFLUORIC ACID — Anhydrous HF available in tank cars of 22- and 42-ton capacity, and in 100- and 200-pound cylinders, from Stauffer's Nyotex Chemicals Division at Houston; aqueous acid in drums and tank cars from Louisville.

SULFURIC ACID — Commercial grades at concentrations of 77.67% up to 122.5%. Oleum at various strengths from 15 to 65% free SO_3; also liquid SO_3. By pipeline, barges, tank cars and tank trucks from factories at Mobile, Ala.; Los Angeles and Richmond, Calif.; Hammond, Ind.; Baton Rouge, La.; Baytown, Fort Worth and Houston, Tex., and various stock points.

TITANIUM TETRACHLORIDE — Technical and C. P. Tank cars and tank trucks; 10-gallon and 55-gallon drums of 130 and 725 pounds net from Niagara Falls, New York.

TITANIUM TRICHLORIDE (Anhydrous) — Available in 1-, 5- and 55-gallon drums packaged under argon atmosphere f.o.b. Richmond, Calif.



LITERATURE AVAILABLE

METAL CHLORIDES:

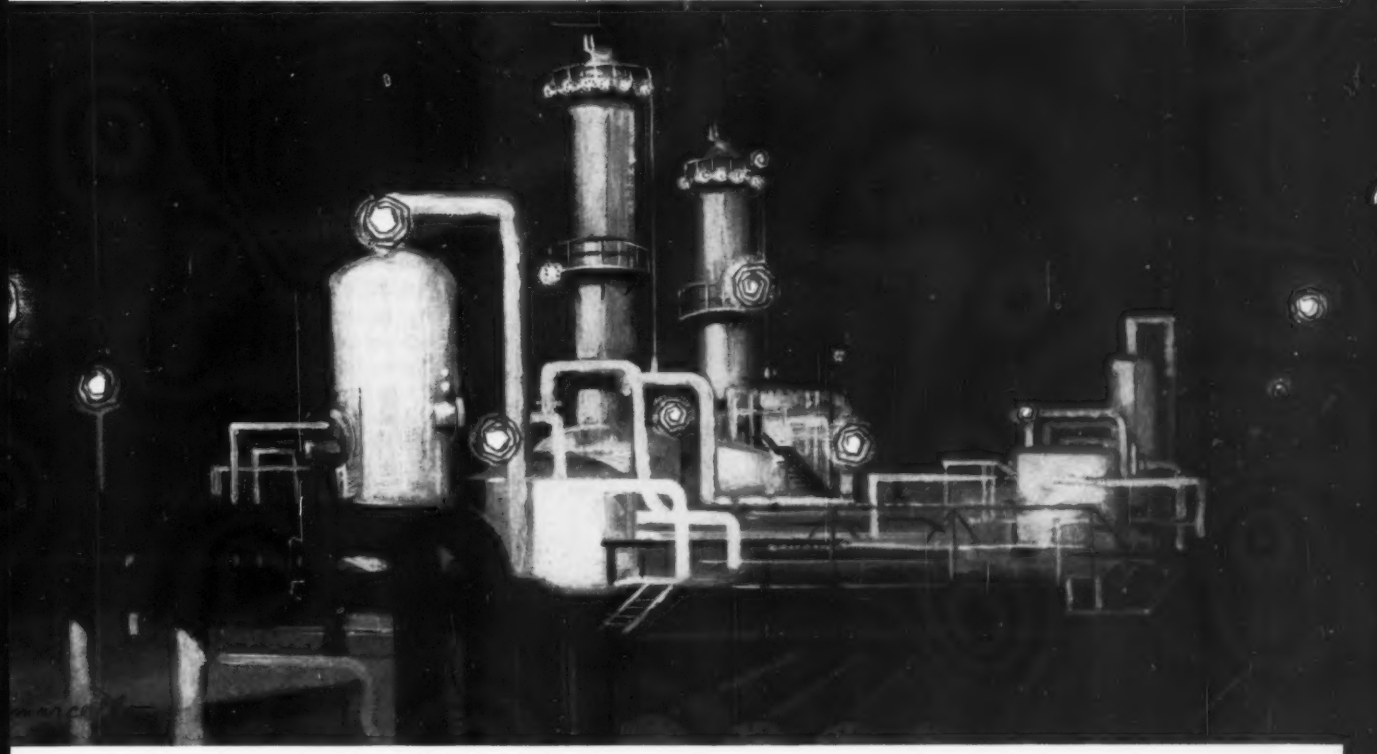
Send for copy of a new and authoritative book on Metal Chlorides. There are sections on chlorides of silicon and zirconium in addition to those described above.

HYDROFLUORIC ACID:

16-page brochure with many graphs and tables and a 24-page pocket-size booklet on Safe Handling and Analytical Methods.

A refinery never sleeps

Twenty-four hours a day, a refinery is in operation. Its hundreds of miles of tubular products are constantly subjected to high temperatures and tremendous pressures. In order to survive under conditions like these, the tube must be hand-picked for the job. And, that's where National Tube comes in. If you need advice in refinery tube selections, get in touch with National Tube.



Our experience in this field comes from more than 60 years of gathering information for the solution of refinery tube problems. And, we've used this data to develop 24 different seamless steel tube analyses—each one the answer to a specific set of refinery conditions. Other chemical compositions are also available in tubular products, and a wide variety of high temperature problems are under study.

National Tube's Mill Service Force, available for field consultation, will be happy to help you find the right alloy, at the right price, to meet your needs. Write to National Tube Division, United States Steel, 525 William Penn Place, Pittsburgh 30, Pennsylvania.

USS and National are registered trademarks

Here are National Tube's two dozen different tube analyses:

Carbon	5 Cr, ½ Mo	17 Cr
Carbon ½ Mo	5 Cr, ½ Mo, 1½ Si	18-8
1 Cr, ½ Mo	7 Cr, ½ Mo	18-8 Ti
1¼ Cr, ½ Mo	8 Cr, ½ Mo	18-8 Cb
2 Cr, ½ Mo	8 Cr, 1 Mo	18-8 Mo
2¼ Cr, 1 Mo	9 Cr, 1 Mo	25-20
2½ Cr, ½ Mo, ¾ Si	12 Cr	3½ Ni
3 Cr, 1 Mo	12 Cr, Al	5 Ni

"The world's largest and most experienced manufacturer of tubular products"

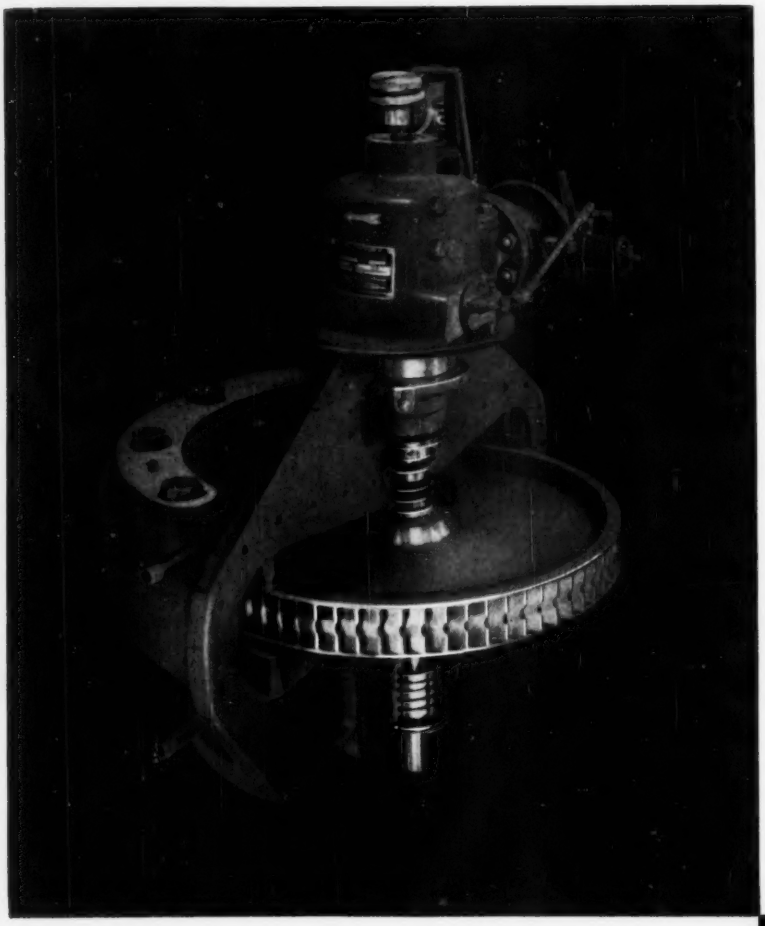
USS National Tube Division of United States Steel

Columbia-Geneva Steel Division, San Francisco, Pacific Coast Distributors
United States Steel Supply Division · United States Steel Export Company, New York

Here's a vertical turbine with

TERRY SOLID WHEEL

and all its advantages



When it comes to judging a turbine's ability to deliver in vertical service, ratings tell only half the story. It's the Terry construction refinements that give you assurance of long-range operational economy: Thrust bearing designed to absorb external pump thrusts ... carbon ring glands specially made for vertical operation ... casings and bearing housings split vertically for easy accessibility.

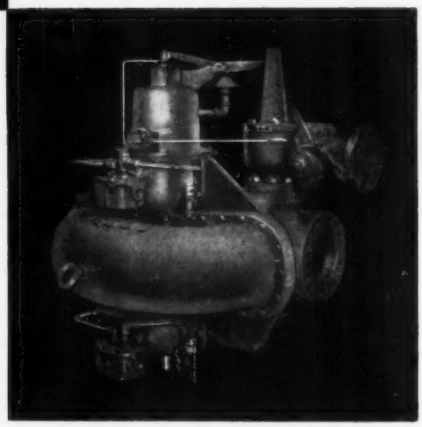
But most important, the Terry vertical turbine has an *almost* indestructible rotor. A single forging of special composition steel, it has no separate parts to loosen or work out. As the only function of the blades is to form a series of pockets, any wear which might occur would not materially affect horsepower or efficiency.

If your application demands a vertical turbine, specify Terry solid wheel. Available in capacities from 5 to 300 horsepower. And remember, the extra durability built into these vertical turbines is typical of every turbine in the complete Terry line.

For further information, send for a copy of bulletin S-137.

THE TERRY STEAM TURBINE CO.
TERRY SQUARE, HARTFORD 1, CONN.

TERRY



TT-1210

at Tidewater's Avon Refinery:

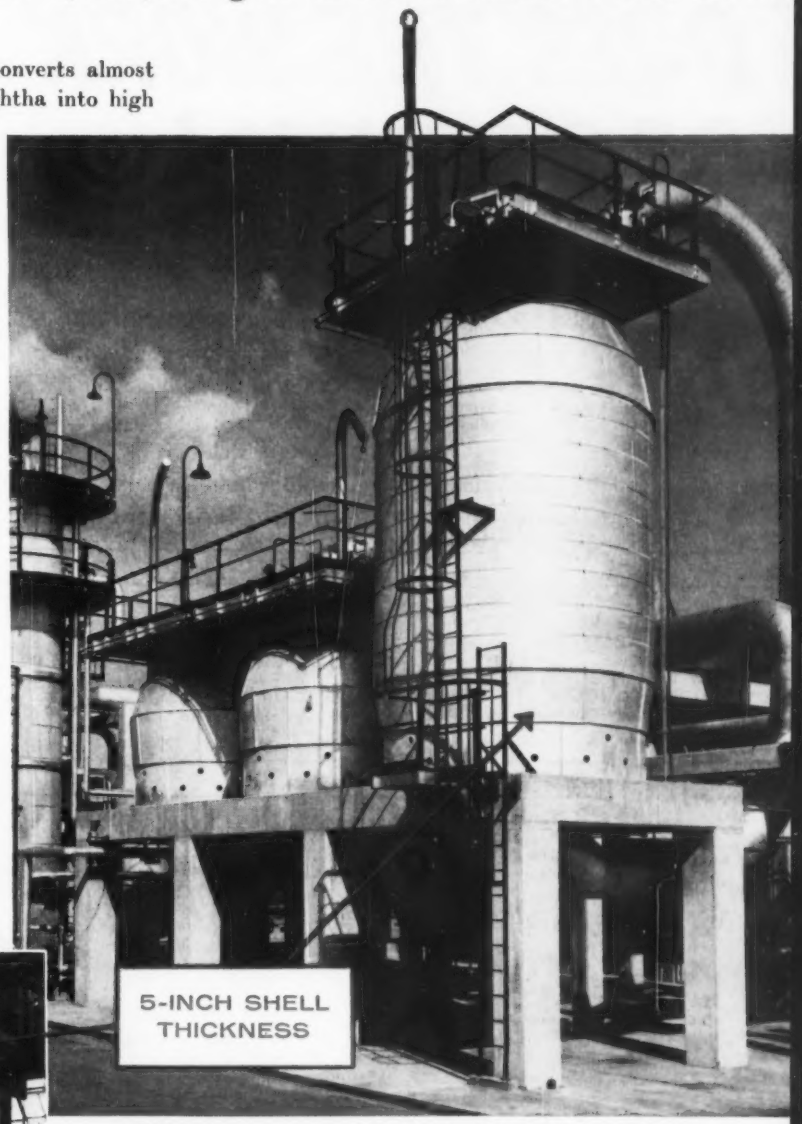
....CB&I-built reactors serve 1,000,000-gal. HOUDRIFORMER Process....

This high severity catalytic reformer unit converts almost a million gallons per day of low octane naphtha into high octane blending stocks.

The three CB&I-built reactors incorporated in the process handle upwards of 127,000 pounds of platinum catalyst per charge. They were fabricated of plates up to 5 inches thick . . . to meet the rigid specifications dictated by extremely high and controlled temperature and pressure conditions. In addition, the critical vessels were shop X-rayed and stress relieved to insure optimum performance and long service life.

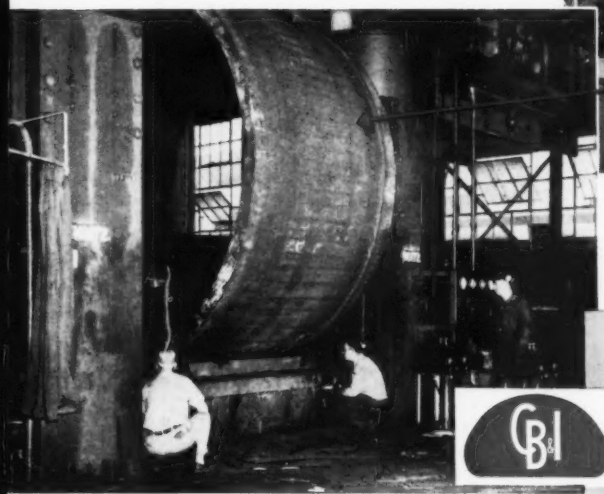
Fabricating 5-inch plate to customer or code specifications is not an unusual job for CB&I. Increased complexity in refining operations demands the exacting attention to detail made possible by CB&I's advanced metallurgical facilities.

Creative fabrication, combined with experienced and *coordinated* engineering and erection services is the reason leading processors rely on CB&I for the tanks, towers and processing vessels which help to keep them abreast of petroleum progress. Write our nearest office for the bulletin: *CB&I Creative Craftsmanship in Steel.*



CB&I-built reactors contain catalyst for *Houdriformer*—high severity reforming process. Hydrogen by-product, generated in process, is recovered for use in another process that removes nitrogen and sulfur compounds from gasoline and propane.

Reactors were furnished through the Bechtel Corporation.



Five-inch thick plate for walls of large reactor (shown above) was fabricated at CB&I Birmingham plant.

Chicago Bridge & Iron Company

Atlanta • Birmingham • Boston • Chicago • Cleveland • Detroit • Houston • Kansas City (Mo.)
New Orleans • New York • Philadelphia • Pittsburgh • Salt Lake City
San Francisco • Seattle • South Pasadena • Tulsa
Plants in Birmingham • Chicago • Salt Lake City • Greenville, Pa. • New Castle, Delaware

SUBSIDIARIES:
Horton Steel Works Limited, Toronto; Chicago Bridge & Iron Company Ltd., Caracas; Chicago Bridge Limited, London; Chicago Bridge Construcoes Ltda., Rio de Janeiro

REPRESENTATIVES AND LICENSEES:
Australia, Cuba, England, France, Germany, Italy, Japan, Netherlands, Scotland

P7903

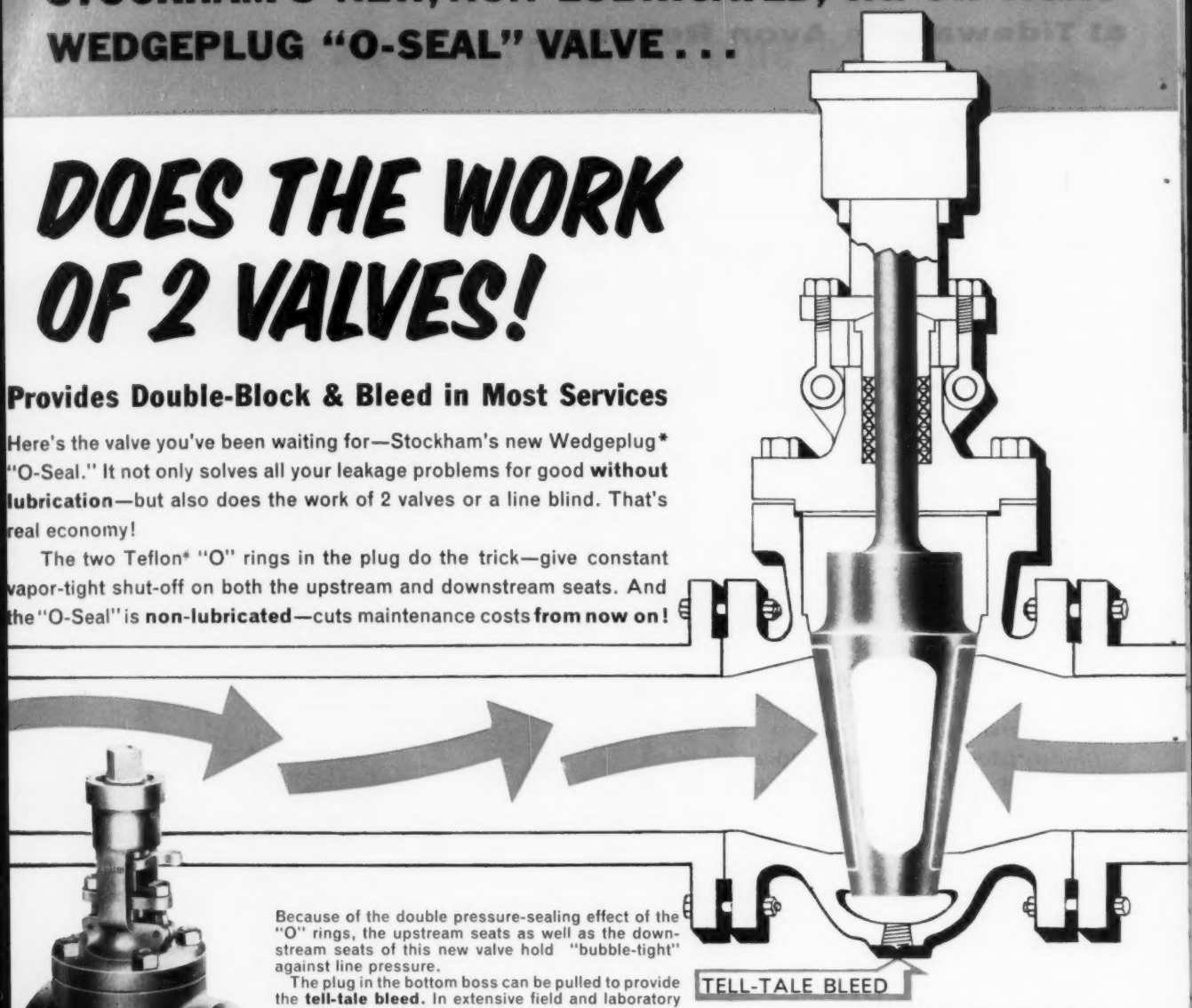
STOCKHAM'S NEW, NON-LUBRICATED, VAPOR-TIGHT WEDGEPLUG "O-SEAL" VALVE . . .

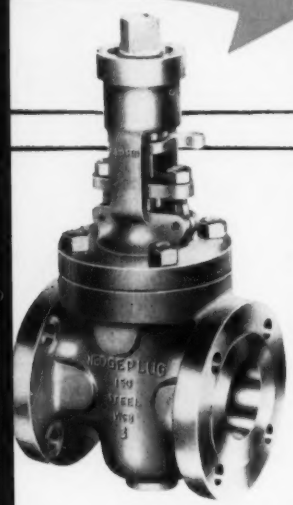
DOES THE WORK OF 2 VALVES!

Provides Double-Block & Bleed in Most Services

Here's the valve you've been waiting for—Stockham's new Wedgeplug* "O-Seal." It not only solves all your leakage problems for good **without lubrication**—but also does the work of 2 valves or a line blind. That's real economy!

The two Teflon* "O" rings in the plug do the trick—give constant vapor-tight shut-off on both the upstream and downstream seats. And the "O-Seal" is **non-lubricated**—cuts maintenance costs **from now on!**





Because of the double pressure-sealing effect of the "O" rings, the upstream seats as well as the downstream seats of this new valve hold "bubble-tight" against line pressure.

The plug in the bottom boss can be pulled to provide the **tell-tale bleed.** In extensive field and laboratory tests, this valve held bottle-tight on the upstream as well as the downstream seats when the bottom plug was removed. There is absolutely no mixing of products in manifolds.

Thus the "O-Seal" can do the job of two ordinary valves or a line blind in most services.

Your Stockham representative will advise you about the recommended services for the "O-Seal's" double-block and bleed feature.

RECOMMENDED USAGES

Stockham's new "O-Seal" is recommended for all general services—air, gas, water, steam, propane, hydrocarbons, etc., as well as for hard-to-hold services. Recommended for temperatures from minus 300° F to plus 400° F and not exceeding 720 psi.

Available in carbon and alloy steels, 2"- 12" sizes, 150 and 300 lb. pressures. Three port openings—40%, 70%, full round-wrench, handwheel, gear, and motor operated.

OTHER OUTSTANDING ADVANTAGES — **Non-Lubricated — no costly maintenance necessary • Absolute shut-off that remains permanently "bubble tight" • Quick, easy operation—won't stick—ever • Double Seating for Double Safety—Ground metal-to-metal seat provides shut-off in case fire burns out "O" rings • No Product Contamination - Protected Seats.**

*Patented
*Teflon: Dupont Trademark

STOCKHAM'S NEW WEDGEPLUG "O-SEAL" VALVE

Call your STOCKHAM Distributor or Sales Representative for complete details, or write today for the new brochure on the Wedgeplug "O-Seal."

Stockham makes a *better* valve . . . for *every* job

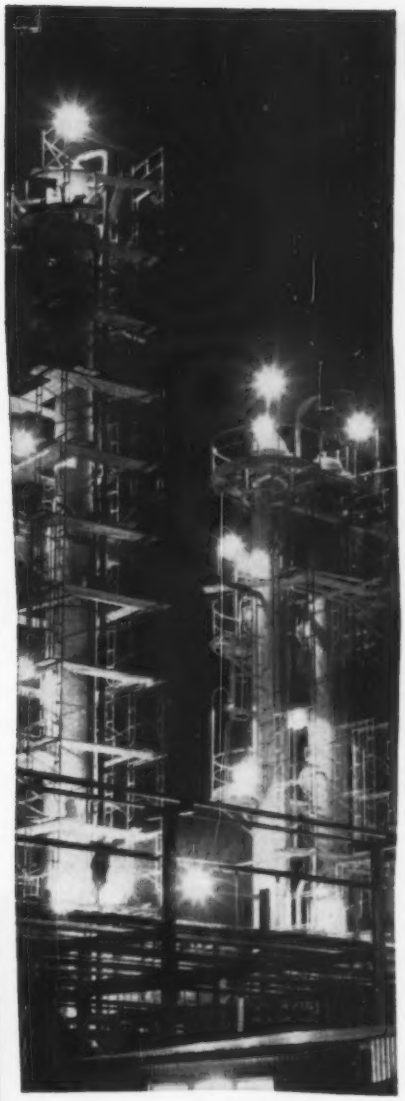
WEDGEPLUG VALVE COMPANY *Division of* → **STOCKHAM VALVES *and* FITTINGS**

General Offices and Plant / 4003 North 16th Avenue, Birmingham 2, Alabama

CAST IRON—MALLEABLE PIPE FITTINGS • BRONZE, CAST IRON, DUCTILE IRON, CAST AND FORGED STEEL VALVES

Drastic reduction of heat loss with **PABCO PRECISION-MOLDED CALTEMP** a Calcium Silicate Insulation

When vapors or liquids are conveyed or held at temperatures up to 1900° F.—when equipment is operated to high heat levels—Pabco insulations cut heat losses to absolute minimums. "Precision-Molded" by a patented process, Pabco's Caltemp and 85% Magnesia pipe and block insulations control temperatures within close tolerances. For data on technical advantages, case histories, or engineering consultation, write . . . or call a Pabco insulation engineer.



INSULATION GUIDE

Temperature	Recommended Pabco Insulation		
to 550°	85% Magnesia pipe covering	block	cement
to 1200°	Caltemp pipe covering	block	cement
to 1500°	Prasco 15 C pipe covering	block	cement
to 1900°	Prasco 19 C	block	

PABCO

INDUSTRIAL INSULATIONS DIVISION

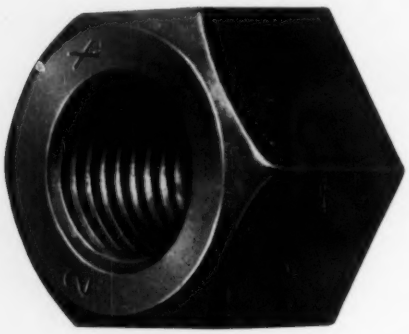
Fibreboard Paper Products Corporation

San Francisco 19 • Chicago 54

Houston 4 • New York 16 • Los Angeles

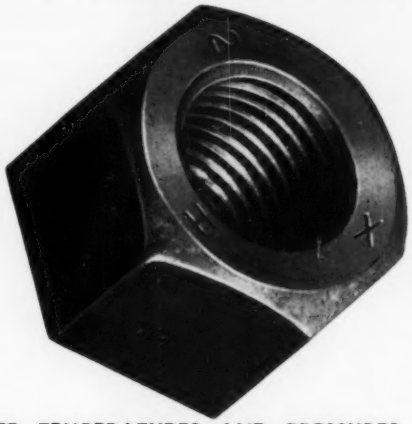
Unusual temperatures and pressures? You can count on these 4 nuts!

These four nuts are the best you can buy for your high or low temperature, or high pressure, applications. Each grade meets a specific operating condition. Each meets ASTM Specification A-194. Each is tapped to Class 2B fit. And each is available in the full size range.



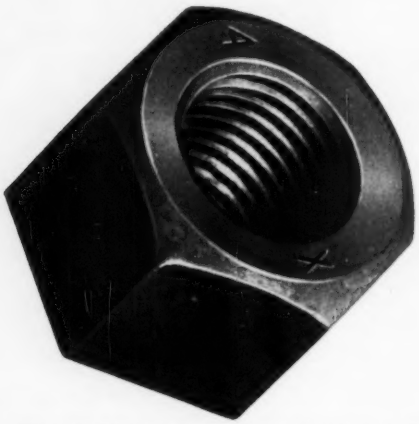
MODERATELY HIGH TEMPERATURES AND PRESSURES. Choose **GRADE 2,** a medium-carbon steel nut.

Carbon	Phosphorus	Sulphur	Brinell Hardness
0.40 min.	0.05 max	0.05 max	160 min



HIGHER TEMPERATURES AND PRESSURES. Choose **GRADE 2H,** a quenched and tempered medium-carbon steel nut.

Carbon	Phosphorus	Sulphur	Brinell Hardness
0.40 min.	0.05 max	0.05 max	248 to 352



SEVERE TEMPERATURES AND PRESSURES. Choose **GRADE 4,** a quenched and tempered molybdenum steel nut.

Carbon	Manganese	Phosphorus	Sulphur	Silicon	Molybdenum	Brinell Hardness
0.40 to 0.50	0.50 to 0.95	0.04 max	0.05 max	0.15 min	0.20 min	248 to 352

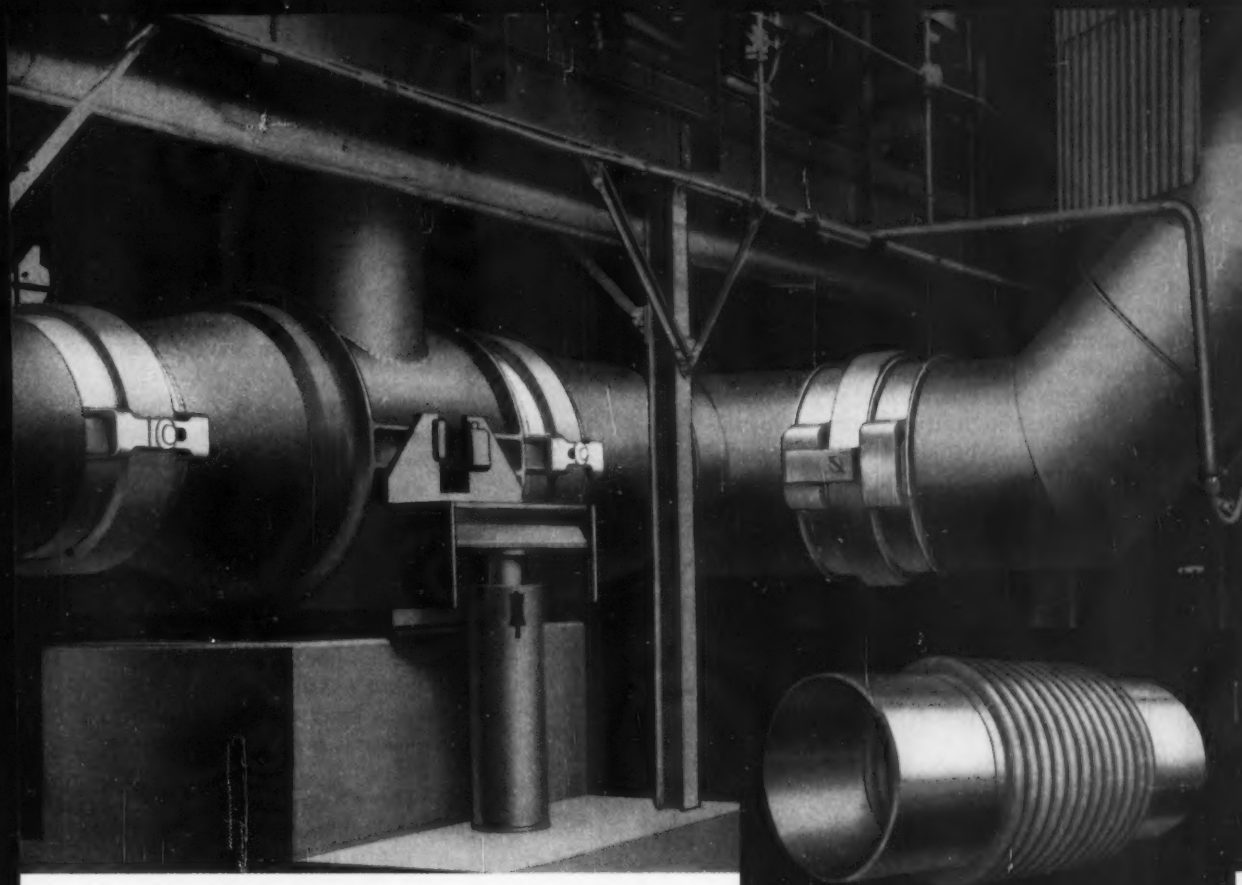
LOW TEMPERATURES. Choose **GRADE 4L,** a quenched and tempered molybdenum steel nut, which meets requirements of ASTM Specification A-320. Minimum Charpy impact value of 15 ft-lb down to —150F.

Whatever you need in nuts, studs, bolts or other fasteners, we can furnish it. Bethlehem makes a full range of standard and special fasteners to meet all refinery needs.

BETHLEHEM STEEL COMPANY, BETHLEHEM, PA.
On the Pacific Coast Bethlehem products are sold by Bethlehem Pacific Coast Steel Corporation
Export distributor: Bethlehem Steel Export Corporation

BETHLEHEM STEEL

BETHLEHEM STEEL



View of hydrocarbon outlet line just below reactors shows three of a total of 67 Badger S-R Expansion Joints at Firestone's new Butadiene Plant at Orange, Texas. Joints shown are equipped with guide bars and external covers.

Series 50W S-R Expansion Joint
Shown with cover removed

Badger S-R Expansion Joints handle rugged 1100° service at Firestone's new plant

The Houdry process used at Firestone Tire and Rubber Company's new Butadiene Plant calls for temperatures up to 1100°. Add critical forces on anchors and connected equipment, wind loading, and complex piping arrangements and you have real problems in piping and expansion joint design.

Working together with Catalytic Construction Co. and Firestone, Badger solved these problems with new Service-Rated (S-R) Expansion Joints. In all, sixty-seven joints have been installed, all of the new Series 50 (low pressure) S-R design. Ranging in size from 30″ to 72″, the joints are arranged singly or in systems of hinged and tandem types to absorb and control pipe line movement (which, due to the piping arrangement, is often axial and lateral — in *two different directions*). Stainless steel bellows are used in all joints; welding nipples are stainless or carbon steel depending on temperatures to be encountered.

Here is another example of a severe pipe expansion problem Badger S-R Expansion Joints and engineering experience have solved successfully. Find out more about the ways they can help you — write today for illustrated brochure.

New corrugation and ring designs produce better equalization, "all-curve" flexing

Curvilinear Corrugations used in S-R Expansion Joints were developed by the Badger Research Department. Under operating pressures (white line) the new design produces more uniform movement per corrugation and natural "all-curve" flexing. Stress is reduced... life increased.

Series 50 corrugation cross-section

S-R Joints for higher pressures have tubular Reinforcing Rings. These new rings make metal-to-metal contact only in the "valley" of each corrugation allowing natural "all-curve" flexing (white line). Tubular shape permits greater effective flexing height which contributes to longer life.

Series 150 corrugation and ring cross-section

BADGER

S·R

SERVICE RATED

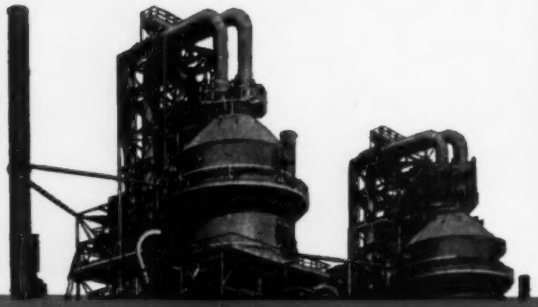
EXPANSION JOINTS

© 1958 BMC

BADGER MANUFACTURING COMPANY
230 Bent St., Cambridge 41, Mass. • 60 East 42nd St., New York, New York
Representatives in Principal Cities

There is a specific A. P. Green Castable for every refractory application in the Petroleum Field. Methods of installation, including troweling, pouring, and "gun" application vary with the particular characteristics of the job. Each A. P. Green castable refractory is specifically designed to provide the required properties of insulation, strength, abrasion resistance and refractoriness for high efficiency operation.

For detailed information and recommendations write the Engineering Department of the A. P. Green Fire Brick Company . . . or call your local A. P. Green distributor.



KAST-SET
A. P. Green KAST-SET is a rapid setting, high strength refractory castable. Mixed with water, it takes on a hydraulic bond without the application of heat. KAST-SET will not shrink, has excellent resistance to abrasion, and is ideally suited for monolithic linings. It may be used at temperatures up to 2700°F.

KAST-O-LITE
A lightweight, insulating castable refractory recommended for temperatures up to 2500°F. It is used for complete monolithic linings in all types of oil stills and heaters, tar stills, air heaters, heat treating furnaces, flues and stacks, and for furnace hearth insulation.

CASTABLE INSULATION NO. 20
A hydraulic-setting castable for temperatures up to 2000°F. Recommended for complete monolithic linings and lightweight panel construction in oil stills and heaters.

CASTABLE BLOCK MIX
A hydraulic-setting castable insulation for temperatures up to 1600°F. CASTABLE BLOCK MIX combines the advantages of a castable material with low conductivity and light weight.

A.P. GREEN

HIGH QUALITY REFRACTORY AND INSULATING CASTABLES ASSURE HIGH EFFICIENCY OPERATION OF PETROLEUM EQUIPMENT

Esso Standard Oil Company's fluid catalytic cracking units at the Baton Rouge Refinery where A. P. Green products are in use.

A. P. Green REFRACTORY PRODUCTS

CASTABLES FOR GUN APPLICATION

SK-7 and KS-4
were designed for use in combination to form composite linings in catalytic regenerators, reactors, and other petroleum equipment. Frequently a lining utilizing only SK-7 or KS-4 will fulfill the requirements of the job.

SK-7
Gun application of SK-7 produces a lightweight lining with excellent strength and insulating efficiency. Ideal lining for ducts, flues and breechings.

KS-4
This strong abrasion resistant castable can be gun applied with a minimum of rebound loss. Recommended for catalytic regenerator linings, stack linings, bubble towers, and duct linings exposed to abrasion or corrosion.

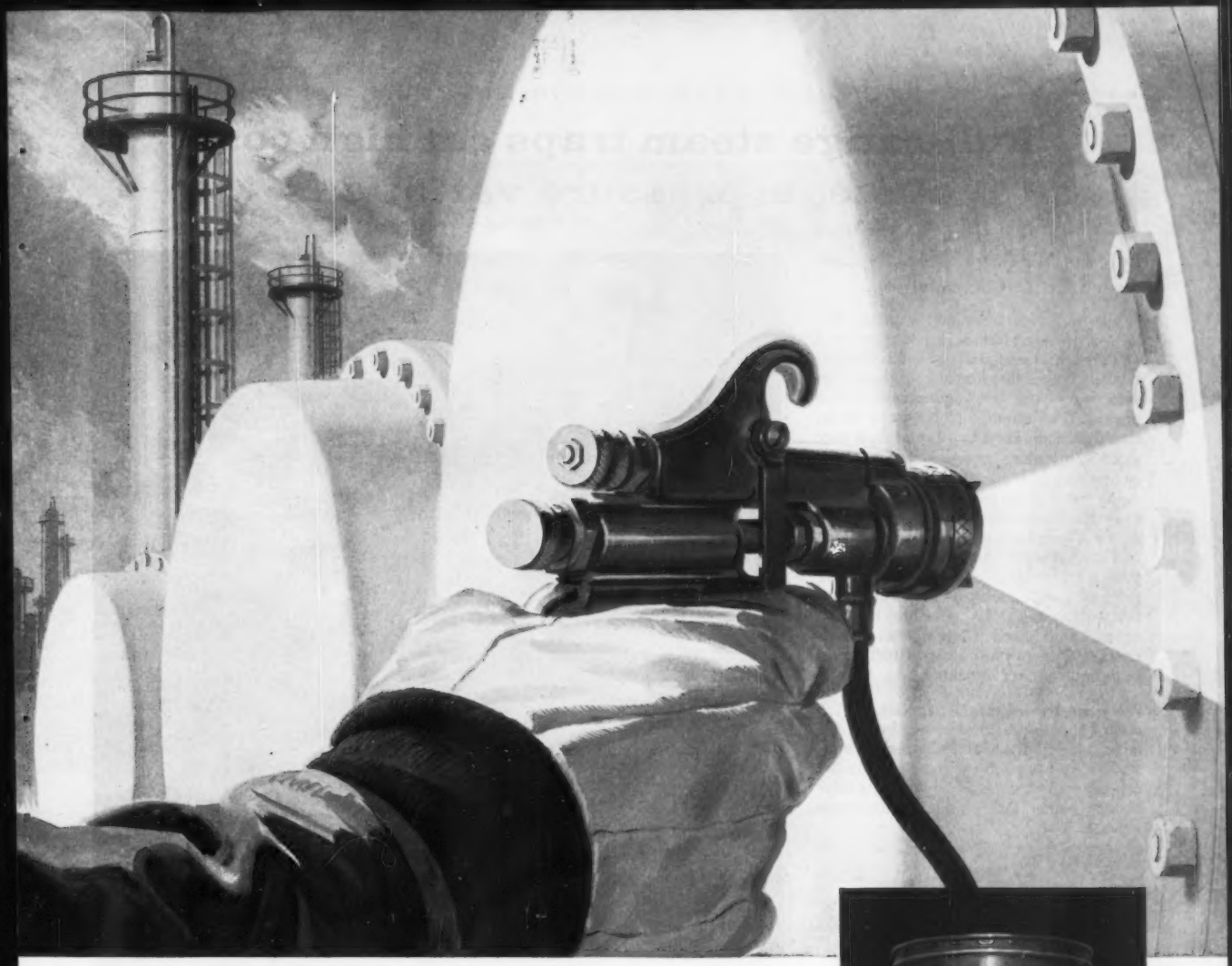
A. P. GREEN FIRE BRICK COMPANY
Mexico, Missouri, U. S. A.

PLANTS:
Mexico, Mo.—Woodbridge, N. J.—Sulphur Springs, Texas, Jackson, Oak Hill, South Webster, Ohio • Philadelphia, Pa. Troy, Idaho • Pueblo, Colo. • Macon, Ga.

IN CANADA:
A. P. Green Fire Brick Company, Ltd.—Toronto 15, Ontario

DISTRIBUTORS IN THE PRINCIPAL CITIES OF THE WORLD

For more data on advertised products, use Readers' Service Cards, last page.



Humble Coatings Give You Three-Way Reduction in Maintenance Costs!

Humble coatings last six months to a year longer than most other paints. You save *two* ways — on paint and labor. The *third,* and most important, way you save is this: you get better protection, which means longer life for expensive equipment.

Humble coatings contain rust-preventing ingredients that not only provide surface protection, but also neutralize any corrosive elements that may penetrate the surface protection and attack the metal. These coatings were specially developed to give maximum protection in refineries and chemical plants where strong acids, alkalis and salt sprays produce severe corrosive conditions.

Without cost or obligation, one of Humble's trained engineers will make a thorough study of your needs and recommend a complete painting program for you. Call your nearest Humble representative, or phone or write:

HUMBLE OIL & REFINING COMPANY
Consumer Sales, P.O. Box 2180,
Houston 1, Texas

Humble's line of coatings includes —

- RUST-BAN ®
- Epoxies
- Phenolics
- Tank coatings
- Vinyls
- Acrylics
- Enamels
- Hot surface coatings
- Interior and exterior emulsion-type paints

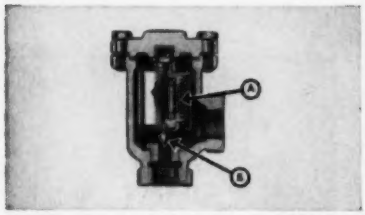
HUMBLE

Full-range steam traps cut high cost of steam pressure variations

By John W. Ritter, Test Engineer
SARCO Company, Inc.

While boiler room economics dictate that boiler pressures remain constant, the equally sound economics of batch processing may decree that pressures at the equipment vary with the requirement of the process. The attempt to choose a steam trap that is all things to all conditions may result in installing traps that operate inefficiently at either extreme of their pressure range or that require adjustment every time the operations sheet calls for another pressure-temperature setting. Orifice traps represent a somewhat more rational approach to the problem, but often at the price of a continuous discharge of steam, particularly at the low pressures of start-up and shut down. Compromise, adjustment, and steam waste all spell inefficiency in the utilization of steam.

Production-Planned steam trapping, on the other hand, improves efficiency by the use of properly designed and installed thermostatic steam traps. Such traps employ the expansion and contraction of a thermostatic element to operate the discharge valve.



In Sarco Thermostatic Steam Trap, element (A) expands at steam temperature to close valve (B), contracts to permit discharge of condensate.

In the Sarco "Balanced Pressure" Thermostatic Steam Trap a volatile fluid is sealed inside a metal bellows that opens or closes the valve as it contracts or expands with condensate temperature. Near steam temperature, evaporation of the fluid creates an internal pressure greater than steam pressure in the trap body, and the expanding bellows seats the valve. When the condensate cools, the element contracts and opens the valve.

It is evident that at steam temperature pressure inside the element is higher than steam pressure, no matter how the latter may vary. Thus, the trap compensates automatically for variations in pressure.

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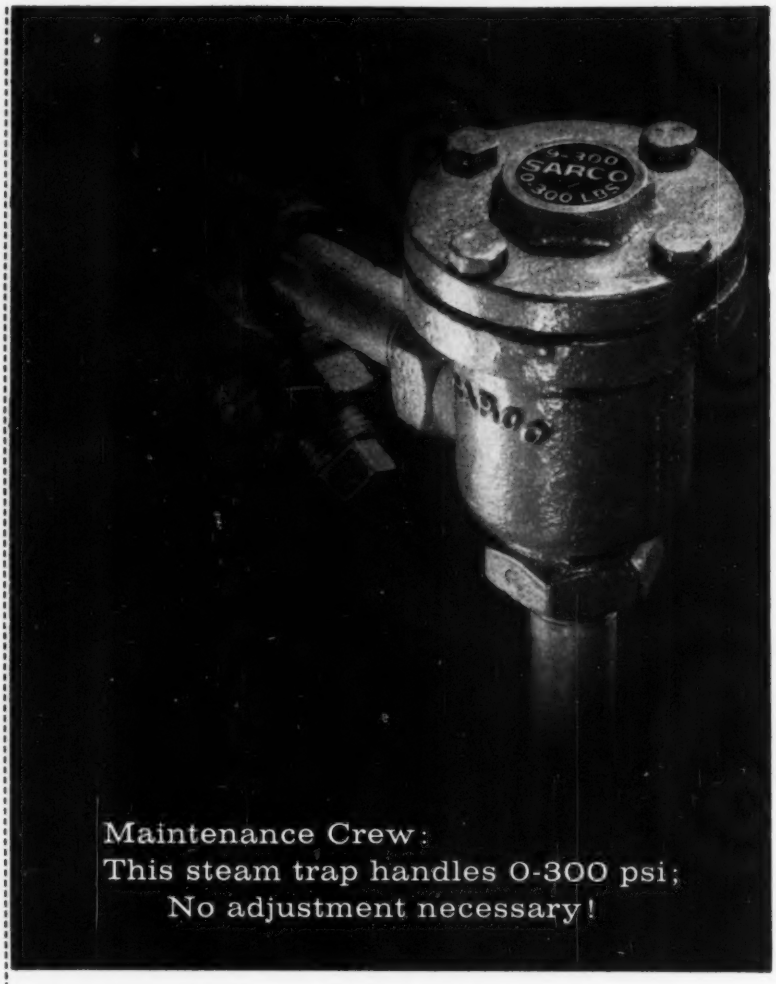


Sarco "Balanced Pressure" Thermostatic Steam Traps cut trap maintenance costs and simplify parts inventory. Why? Because the same bellows, head and seat handle steam pressures up to 300 psi – without any need of adjustment for variations in load or pressure.

Other advantages: unmatched capacity/cost ratio (1" size discharges 9,650 lbs/hr. at 10°F below steam temperature, 125 psi). This trap can't air-bind and, when installed with free discharge, can't freeze.

Long life and reliable performance are assured by an exclusive Sarco process for fabricating the one moving part – the thermostat – and by steam-testing of every single trap at maximum rated pressure.

Write for "Literature Kit 1A" today. And remember, Sarco can give you impartial advice on *Production-Planned* steam trapping because . . .

SARCO
COMPANY, INC.
635 Madison Ave., New York 22, N. Y.

Only Sarco makes all 5 types:
Thermostatic • Liquid Expansion • Float Thermostatic
Thermo-Dynamic • Bucket

STEAM TRAPS • TEMPERATURE CONTROLLERS • STRAINERS • HEATING SPECIALTIES

For more data on advertised products, use Readers' Service Cards, last page.

"Ferulok"® flareless fittings in steel and stainless steel for fast, easy installations on either thin-wall or heavy-wall tubing from ⅛" to 2" O.D.

Only from Parker

so complete a range of tube fittings for process and instrument lines

Select the proper tube fittings for any of your process or instrumentation lines from hundreds of different sizes, shapes and alloys in the Parker fittings line.

Parker "Intru-lok" fittings for fast, easy assembly of low- and medium-pressure lines in metal or plastic tubing. Fittings come ready to use without disassembly.

"Triple-lok" flare-type fittings make up leak proof on high pressure, high temperature lines. They are ASME-approved, ideal where safety is vital.

Leak-free, vibration-proof "Ferulok"® flareless, bite-type fittings hold pressure-tight on thin-wall or heavy-wall steel or stainless tubing. For semi-permanent joints on critical applications, use "Braze-lok" fittings on O.D. tubing. And use "Weld-lok" for highest temperatures and pressures.

Call your Parker fittings distributor for prompt delivery of Parker fittings from local stocks. He can also offer expert advice on any process or instrument tubing installation.

"Intru-lok" brass or aluminum flareless fittings for fast, easy installations on either plastic or metal tubing. (⅛" to 1" O.D.)

"Weld-lok" in steel and stainless steel for highest temperatures. "Braze-lok" in stainless steel, monel and Naval brass, silver-brazed for strength and reliability. (⅛" to 2" O.D.)

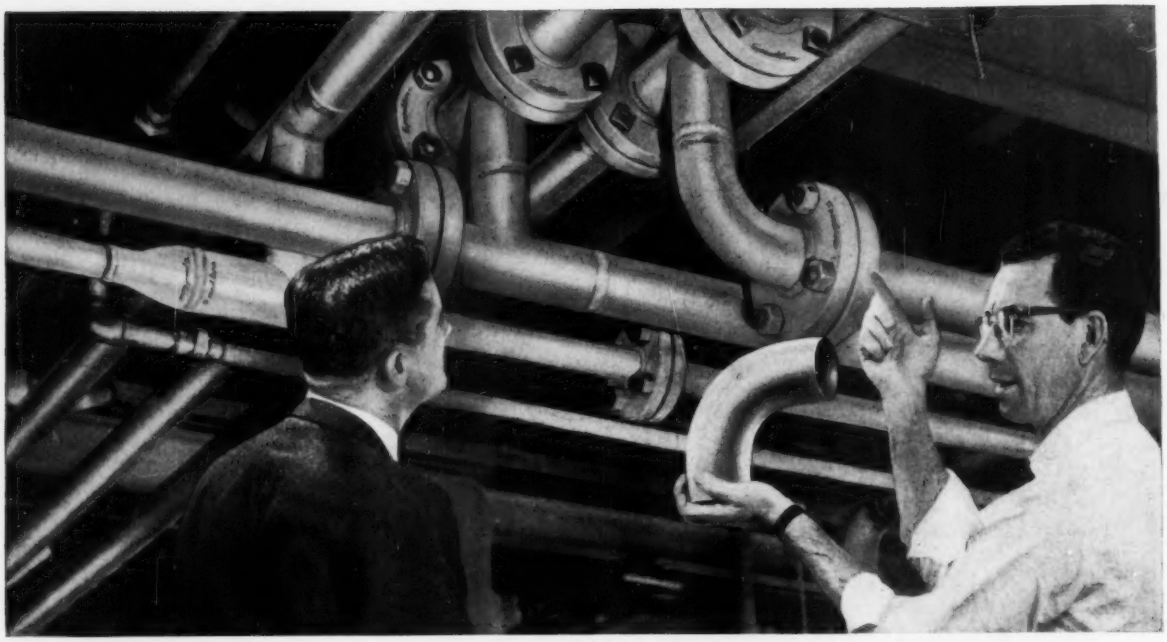
"Triple-lok" 37° flare-type fittings in brass, aluminum, stainless, and cadmium-plated steel for safe, trouble-free service. (⅛" to 2" O.D.)

Parker FITTINGS AND HOSE DIVISION

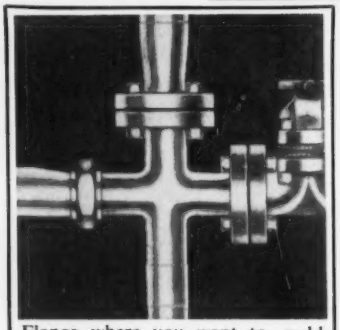
17325 Euclid Avenue • Cleveland 12, Ohio

A DIVISION OF PARKER-HANNIFIN CORPORATION

For more data on advertised products, use Readers' Service Cards, last page.



SPEEDLINE'S EXTRA LENGTH FEATURE GAVE US MORE PIPE PER FITTING DOLLAR



Flange where you want to, weld where you want to . . . any type joint can be used with any Speedline fitting. The longer straight section provides ample clearance that simplifies installation and permits easier hook-up of valves, flanges, etc. even in confined areas. The extra length feature is common to all Speedline Ells, Tees, Crosses, Reducers and Bends.

SEE DISTRIBUTOR LISTING PAGE 593 IN CHEMICAL ENGINEERING CATALOG.

Extra length on *every* end of *every* Speedline corrosion resistant fitting adds up to *real* savings in pipe costs, compared to systems using conventional fittings (see table).

Time and labor costs are also reduced from preliminary design to finished installation. Design detailing is minimized because any type joint can be used on any—or *all*—ends of a Speedline fitting. Speedline's longer length gives more clearance for welding and faster, *easier* pipe aligning . . . permits flanging *without* welding by a simple rolling-in operation! And because Speedline fittings are specially designed for use with low cost, light wall stainless pipe, material costs are substantially lower from the start.

Specify Speedline for your process lines—first in the industry to offer *extra* length for *greater* economy. Write for *free* catalog.

SPEEDLINE'S EXTRA PIPE LENGTH BONUS

I.P.S. SIZE	½"	¾"	1"	1¼"	1½"	2"	2½"	3"	4"
90° Elbow	2½"	3"	2¾"	2½"	2½"	3"	2½"	4"	4½"
45° Elbow	2½"	3"	2¾"	2½"	2½"	3"	2½"	4"	4½"
Tee	4⅛"	4½"	4⅛"	3¾"	3⅜"	4½"	4⅞"	4⅞"	4⅞"
Cross	5½"	6"	5½"	5"	4½"	6"	6½"	6½"	6½"

With 100-2" Speedline elbows you get 25' more pipe than with conventional fittings. How do these pipe savings add up for your requirements?

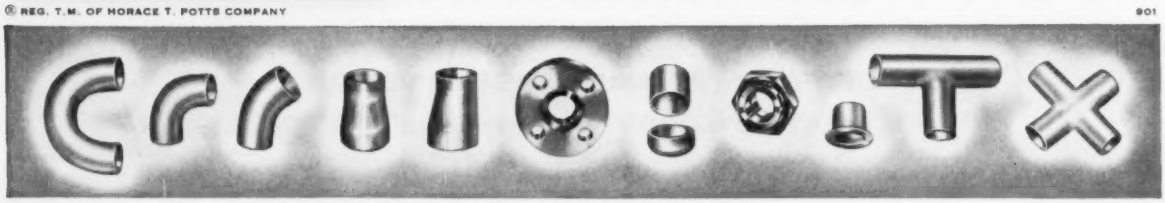
Speedline®

STAINLESS STEEL FITTINGS

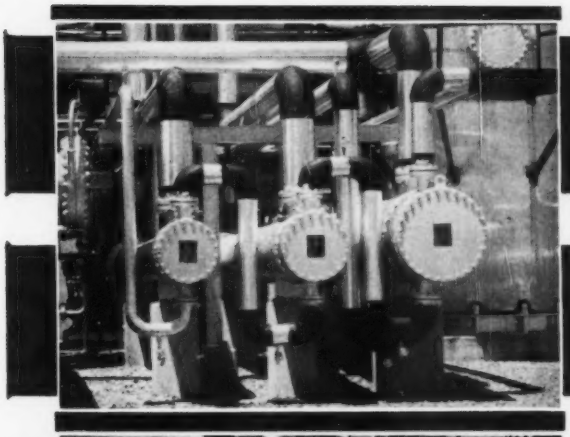
SPECIALLY DESIGNED FOR SCHEDULES 5 AND 10 PIPE

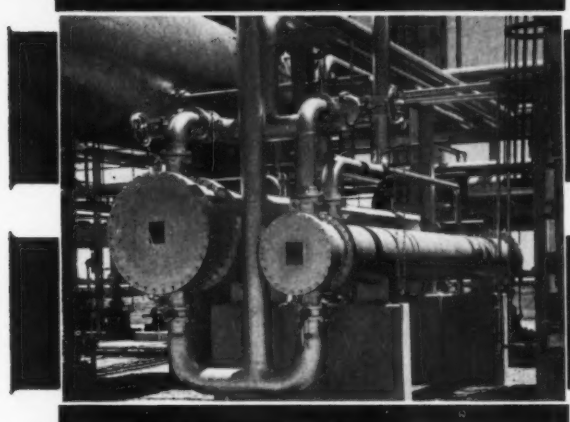
® REG. T.M. OF HORACE T. POTTS COMPANY

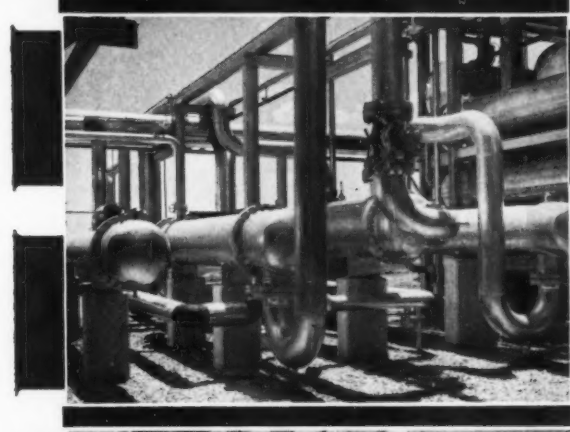
901

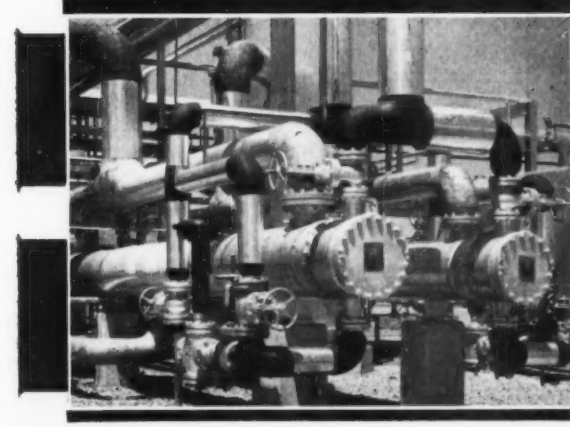


Manufactured by HORACE T. POTTS COMPANY • 566 E. Erie Ave., Philadelphia 34, Pa.









"HEAT EXCHANGERS"

produced and directed by

WESTERN

for

CONTINENTAL OIL CO.'S Short Junction Plant

Engineered by

TULOMA BUILDERS, INC.

featuring

- absorber inter-cooler
- gas to gas exchangers
- gas to oil exchangers
- inlet gas chiller
- cold oil exchangers
- glycol reboiler
- depropanizer reboiler
- debutanizer reboiler
- rich oil deethanizer reboiler
- lean oil chiller

Western was privileged to furnish the heat exchangers specified for the Continental Oil Short Junction plant in Cleveland County, Oklahoma . . . with all delivery schedules met well in advance.

Western's ability to work closely with the contractor in engineering, designing and manufacturing heat transfer equipment, allowed Tuloma Builders to proceed uninterrupted with the construction plans for the Short Junction plant.

Western's leadership in the manufacturing and distribution of heat exchangers has been built on this capacity for close attention to detail, technical excellence and highest quality.

WESTERN

HEAT EXCHANGERS

WESTERN SUPPLY COMPANY

P. O. Box 1888 — Tulsa, Oklahoma

For more data on advertised products, use Readers' Service Cards, last page.

STRATCO
Reg. U. S. Pat. Off.

VACUUM FLASH EVAPORATOR

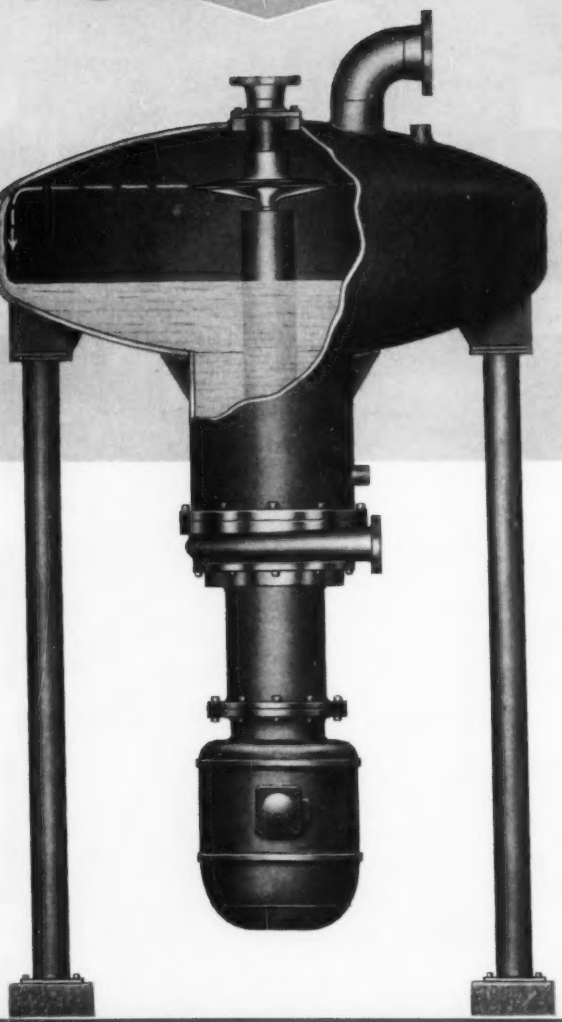
For Continuous Dehydration and Degasification

Designed for removal, under vacuum, of small percentages of volatile liquids or gases from higher boiling point liquids.

Widely employed in continuous lube compounding plants for brightening of lubricating oils.

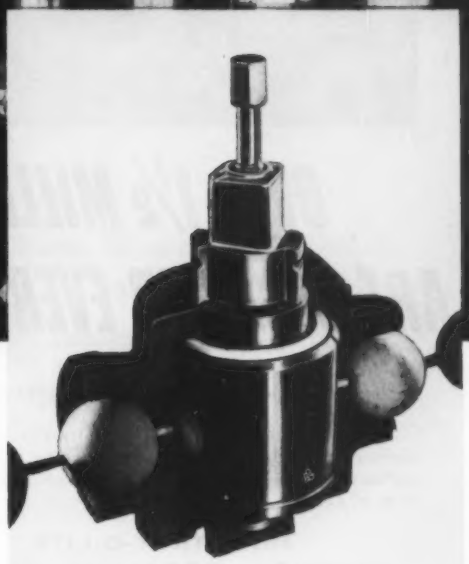
Available in sizes ranging from bench scale laboratory units to commercial 500 GPM units.

Modified flash evaporators, with capacities to 50 GPM are available for continuous grease dehydration and polishing.



Representatives
D. D. Foster Co., Pittsburgh
D. D. Foster Co., S. Charleston, W. Va.
Lester Oberholtz, Los Angeles
Rawson-Houlihan Co., Inc., Houston
The Rawson Co., Inc., Baton Rouge
F. J. McConnell Co., New York

STRATFORD ENGINEERING Corporation
612 West 47th St. PETROLEUM REFINING ENGINEERS Kansas City 12, Mo.



W-K-M's *Creative Engineering* has solved your plug valve problem!

Users of ACF Lubricated Plug Valves are enthusiastic about the performance of their valves.

Whatever the service . . . whether the valves are small or large . . . whatever the lading . . . ACF Lubricated Plug Valves handle the most difficult valve jobs.

For example: The shearing action of the cylindrical plug cuts through tough, stringy slurries clean as a knife—no stoppages, constant flow.

For example: You can see excess lubricant as it escapes around the neck of the plug—no build-up of excessive lubricant pressure; no lubricant forced into the line.

For example: Special design requires a minimum amount of lubricant for servicing.

For example: The valves may be installed in any position, and they fit into the smallest possible space.

Specify ACF when your job calls for plug valves. They'll give you dependable performance, long life and economical operation.

acf®

Lubricated Plug Valves

with round port, full pipe area

This is the valve for heavy fluids and ladings. When open, the round port becomes an exact continuation of the pipe. There is no change in velocity, area, direction or cross-section of the lading. There are no pockets to trap the lading, and seating surfaces are sealed away from contact with the fluid flow.

• • •

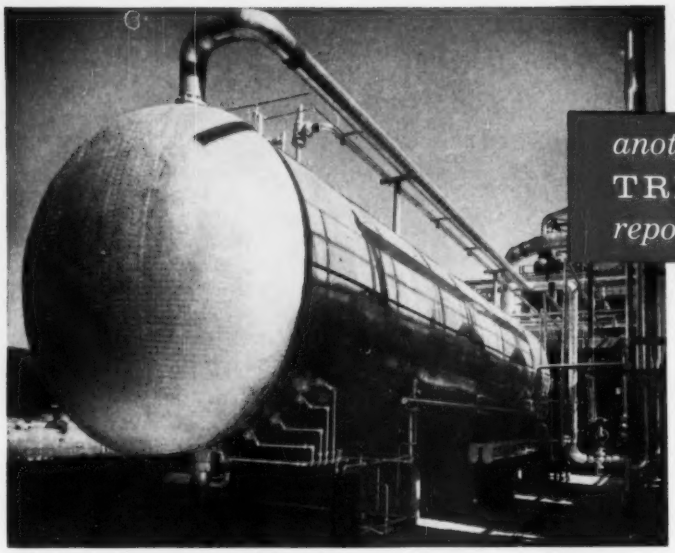
W-K-M provides a complete line of specially formulated lubricants for ACF Lubricated Plug Valves. Write for Catalog 800 for ACF lubricant recommendations.

WRITE FOR CATALOG 400

W-K-M

DIVISION OF acf INDUSTRIES
INCORPORATED
P. O. BOX 2117, HOUSTON, TEXAS

9032



See our exhibit at the International Petroleum Exposition, Tulsa, May 14-23, and 5th World Petroleum Congress, New York, June 1-5.

another
TRETOLITE SERVICE
report

OVER 1½ MILLION BARRELS OF CRUDE OIL ARE DESALTED EVERY DAY BY TRETOLITE DESALTERS

...average cost: $.0013 per barrel!

TRET-O-LITE* Chemical Desalters are at work in refineries throughout the world, reducing salt contents in the 95% to 100% range, at an average total chemical cost of about 1.3 mills per barrel.

HOW TRET-O-LITE CHEMICAL DESALTING WORKS

The quantity of the proper TRET-O-LITE destabilizer is proportioned into the crude suction line of the charge pump to assure complete dispersion. Washwater (5% by volume of crude charge) is injected immediately following the charge pump. An optional water injection point in the crude suction line is provided for additional water-to-oil contact. The oil, chemical and washwater mixture are elevated to operating temperature, passed through an emulsifying valve, and through a Tretolite-designed coalescing section to promote particle growth. The mixture then enters the desalting vessel which is internally designed to provide additional water-washing and oil residence time. The salt-free crude flows directly to the still and the effluent saline water to the sewer.

*TRET-O-LITE *is a registered trade-mark of Petrolite Corporation*

4-WAY CHOICE AVAILABLE TO TRET-O-LITE DESALTER USERS

Four plans are available for installing efficient TRET-O-LITE Chemical Desalting at your refinery: **1.** *Standard Proposal.* Construction according to plans and specifications supplied by TRET-O-LITE; **2.** *Standard Proposal (With Guarantee).* An engineering fee is charged when operating efficiency and TRET-O-LITE desalting ratios are guaranteed. An acceptance test is conducted to assure that guarantees are met; **3.** *Outright Purchase.* Tretolite delivers all equipment for erection by refiner or his contractor; **4.** *Rental with option to purchase.* Equipment furnished for erection by refiner with payment based on predetermined annual rental fee.

All plans receive thorough Tretolite inspection during construction, as well as supervision during start-up and acceptance tests.

For complete information *ask the Man in the Red Car.* Or write to...

TD 59-1

PETROLITE CORPORATION

TRETOLITE COMPANY
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369 Marshall Avenue, Saint Louis 19, Missouri
5515 Telegraph Road, Los Angeles 22, California

CANADA: Petrolite Corporation of Canada, Limited, 309 Alexandra Bldg., Edmonton, Alberta

COLOMBIA: South American Petrolite Corporation, Calle 19, No. 7-30, Office 807, Bogota

ENGLAND: Petrolite Limited, 46 Mount Street, London W. 1.

VENEZUELA: South American Petrolite Corporation, Hotel Avila, Caracas

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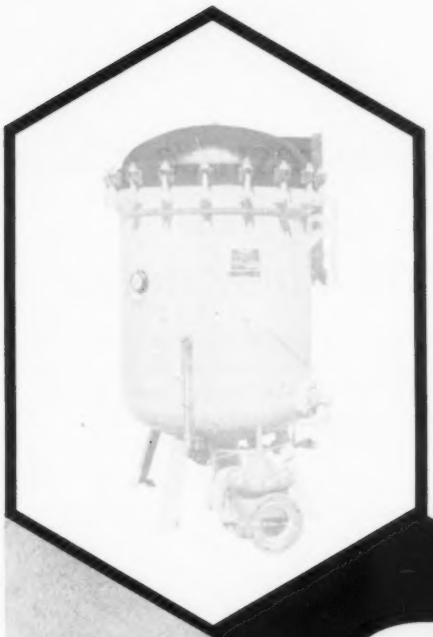
MEXICO: R. E. Power, Sierra de Mijes, No. 125, Mexico, D. F.
NETHERLANDS: F. E. C. Jenkins, Hoefbladlaan 134, The Hague
PERU: International Gas Lift Company, Apartado 71, Talara
TRINIDAD: Neal and Massy, Ltd., Port of Spain, P.O. Box 544

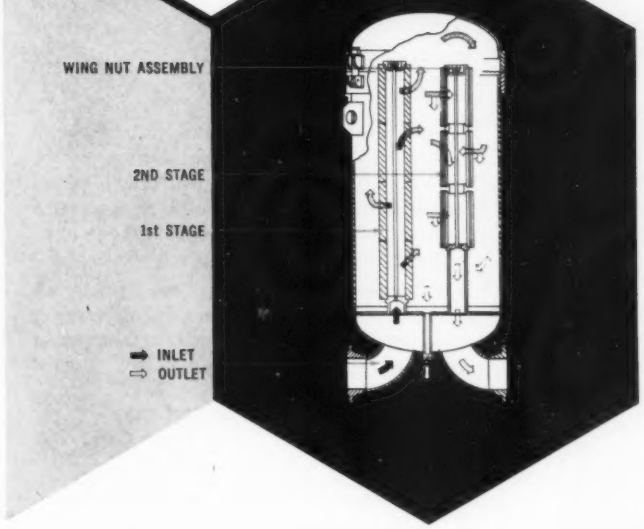


PROBLEM:

WATER AND DIRT IN PETROLEUM PRODUCTS

SOLUTION:

WARNER LEWIS TWO STAGE SEPARATOR/FILTERS



For Process, Pipeline and Marketing Facilities

HOW IT WORKS

1st Stage — Coalescing-Filtering

Hydrocarbon and water enter inlet and pass through the coalescer cartridges where solids such as dirt, rust and scale are removed and mechanical emulsions are broken. Finely dispersed water droplets gather together into large water droplets and fall by gravity into the water-collecting sump.

2nd Stage — Separating

Clean hydrocarbon and any entrained water droplets flow to the separator cartridges. This chemically-treated media completely blocks the passage of water and clean hydrocarbon passes through the cartridges to the outlet.

Two stage design provides positive protection against contaminated products not possible in single stage designs.

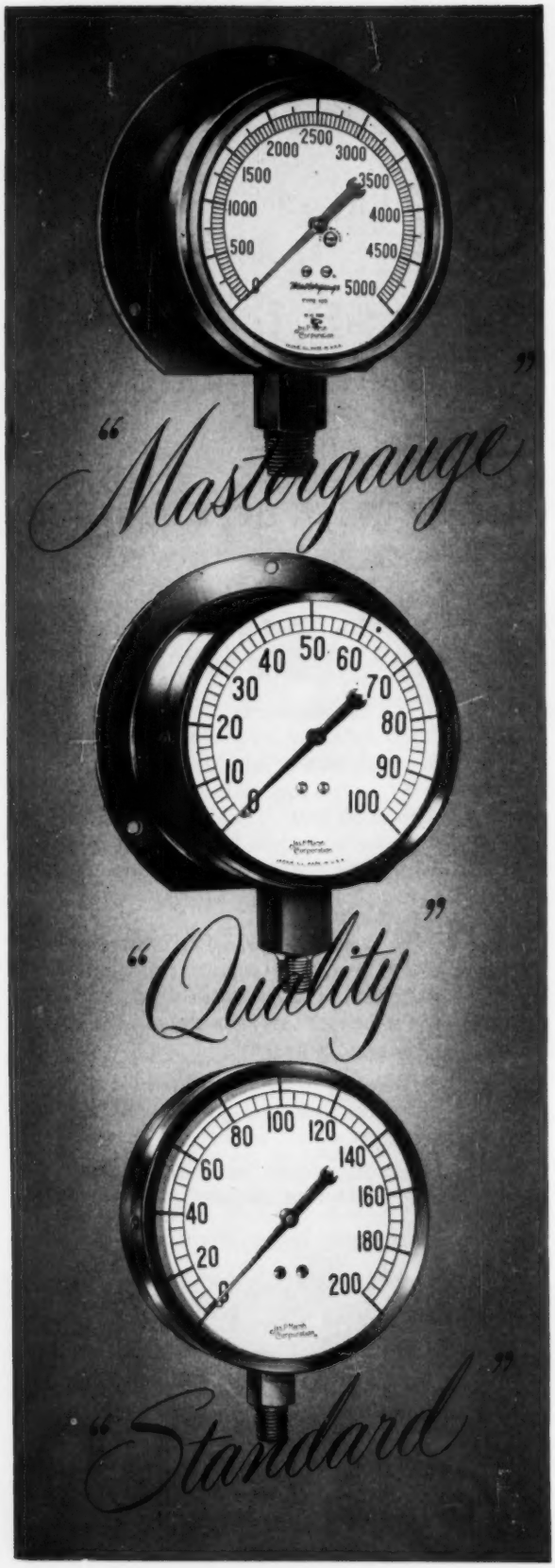
Replacement cartridges feature high dirt holding capacity and low cost replacement.

Write Process Section, Warner Lewis Company, for details.

WARNER LEWIS COMPANY

BOX 3096 • TULSA, OKLAHOMA

DIVISION OF FRAM CORPORATION



What pressure gauge for your particular need?

The clear-cut economical answer to your specific gauge problem is right here in the Marsh line. It is here because the Marsh line contains the world's most complete range of gauges in the three broad brackets of gauge applications.

THE "MASTERGAUGE" GROUP...for those extreme services that demand the ultimate in gauge precision, accuracy and stamina.

THE "QUALITY" GROUP...also for tough conditions, but less severe than the conditions served by the "Mastergauge" Group.

THE "STANDARD" GROUP...for the general run of pressure gauge services.

While these three brackets run a wide gamut of prices, the difference between them is not so much a matter of *grade* as a matter of *kind* and *purpose*. All gauges in all groups reflect Marsh precision and quality. Collectively they cover practically every conceivable gauge requirement.

The answer is in the catalog...but if you have a special problem let our engineering department work with you to select the most efficient, most economical solution to your problem.

MARSH INSTRUMENT CO.
Sales Affiliate of Jas. P. Marsh Corp.
Dept. R, Skokie, Illinois.
Marsh Instrument & Valve Co., (Canada) Ltd.,
8407 103rd St., Edmonton, Alberta, Canada.
Houston Branch Plant, 1121 Rothwell St.,
Sect. 15, Houston, Texas

MARSH

"THE STANDARD OF ACCURACY"

For more data on advertised products, use Readers' Service Cards, last page.

"Life-Blood" of a Large Refinery!

BS&B Super 70 Diaphragm Control Valves with Clamp Ring—Float Ring Body Closure.

This natural gas metering station feeds 100 MMSCF of gas per day to a large Gulf Coast Refinery. If it were necessary to shut down the station for repairs, operation of the refinery would be seriously impaired.

That's why engineers who designed the station wanted to be absolutely sure the control valves would function properly day in and day out under all operating conditions.

Because of their superior performance characteristics and rugged dependability . . . and because of BS&B's reputation for quality products and dependable service in the oil industry . . . BS&B Super 70 Control Valves were selected. Now "on stream", they are performing well in every respect.

BS&B Super 70 Valves are available in a complete range of sizes . . . with either clamp ring—float ring, or flanged—gasketed body closures. Specify them on your next job!

BLACK, SIVALLS & BRYSON, INC.

Controls Division,
Dept. 4-F3
7500 East 12th Street
Kansas City 26, Missouri

SUPER BS&B 70

For more data on advertised products, use Readers' Service Cards, last page.

for TANK FARM Inventory Control

"Varec" Pulse Code

DATA GATHERING AND REDUCTION SYSTEM

For handling such variables as LIQUID LEVEL *(in feet, inches and eighths; metric in millimeters or feet and hundredths)*; TEMPERATURE *(one degree increments to three digits)*; PRESSURE *(three digits in one or ten pound increments)*; FLOW VOLUME *(to five or six digits in one or ten barrel increments or other volume units)*. The system will also log the status and provides for the control of operating equipment such as valves, pump motors, etc. Time data and identification points can be recorded as needed to suit the operation. Flexibility is one of the system's outstanding features since it allows the use of standard proven systems for custom applications that would otherwise require special-built, untested units.

FLEXIBLE ARRANGEMENT

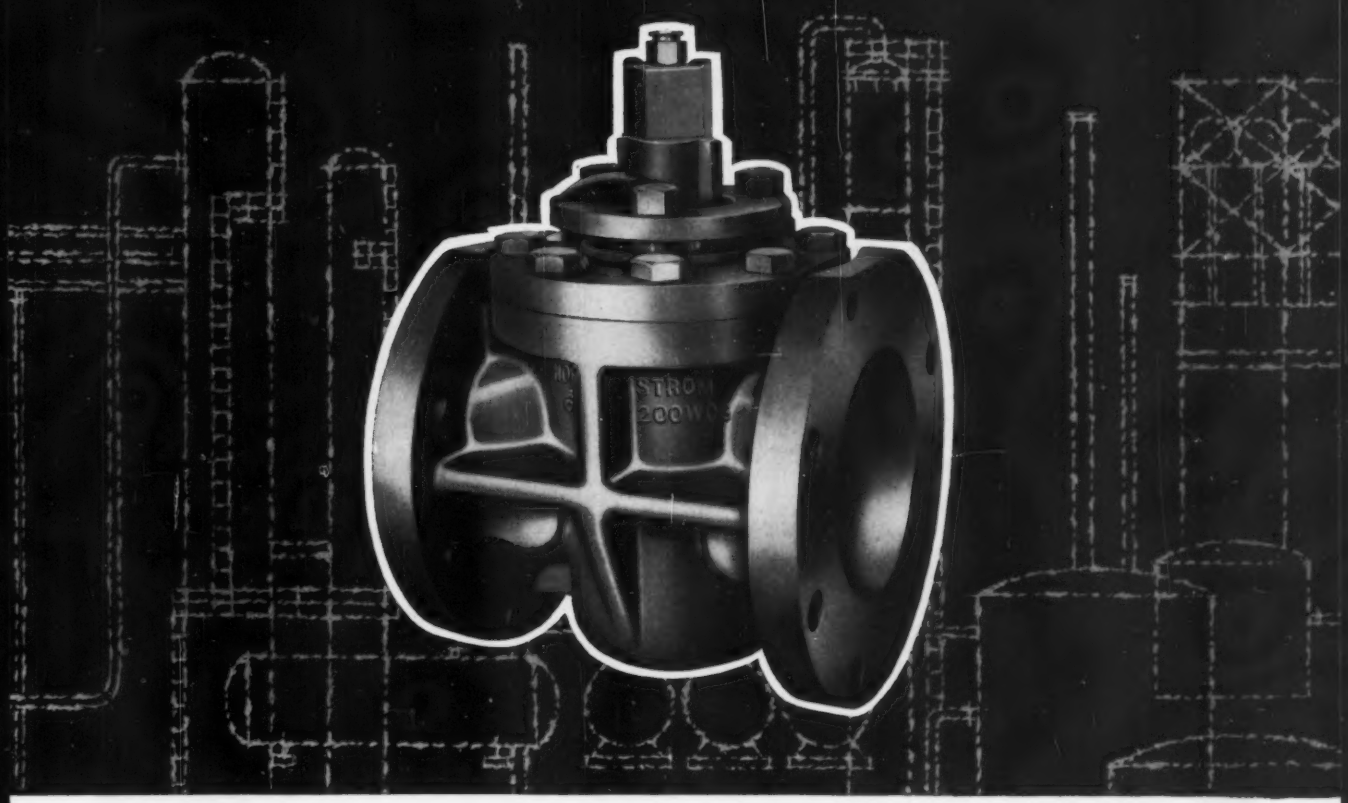
Almost any type of logging program can be arranged by using standard sub-assemblies: Logging on prearranged form, with or without point identification, or on random order basis with point identification •••••• Entry of one or more lines of data for log cycle •••••• Time entry at start of each line entry. All numbers, fractions and letters available for logging; carriage shift; black-red ribbon shift provisions.

FLEXIBLE OPERATION

Manual operation without Data Logging by means of a telephone dial which obtains a visual indication of any point included in the system ••••• Manual control of Scanning-Logging Cycle can be started at any time by the operator at any desired point ••••• Automatic Control of Scanning-Logging Cycle can be initiated on a time programmed basis by time clock control.

FOR A COMPLETE ENGINEERING APPROACH TO TELEMETERING SYSTEMS REQUEST PACKAGE 24

THE VAPOR RECOVERY SYSTEMS COMPANY • COMPTON, CALIFORNIA



NEW! ROCKWELL-Nordstrom VALVES

WITH SPECIAL CORROSION RESISTANT COATINGS

Here are two important new additions to the Rockwell-Nordstrom line of corrosion resisting lubricated plug valves. Rockwell-Nordstrom valves are now available with the following special coatings to make them fully corrosion resistant in many refining and chemical plant services:

KANIGEN COATING(1): a chemical method of applying a 90%-92% nickel—8%-10% phosphorous coating to iron or steel valves. The internal-external coating of Kanigen assures the corrosion resistance of nickel and stainless steel on most corrosive services.

K-51 COATING(2): a halogenated ether polymer applied by the patented Whirlclad Process(3) on inner and outer surfaces of standard valves. With K-51 coating, iron and steel valves become exceptionally resistant to attack by most acids, caustics, brines, inorganic solvents and many organic solvents.

Send for complete details on how the new Rockwell-Nordstrom coated valves can help you solve your corrosive flow control problems. Get the facts, too, on special weld-coat "*hard faced*" valves and more than 300 patterns in special metals such as bronze, nickel, Monel, Ni-Resist, Stainless and many others.

Rockwell Manufacturing Co., Pittsburgh 8, Pa. Canadian Valve Licensee: Peacock Brothers Ltd.

SEND FOR COMPLETE DETAILS

(1) Applied by General American Transportation Corporation.

(2) (3) K-51 Penton and Whirlclad are patented by National Polymer, Inc.

ROCKWELL-Nordstrom VALVES

another fine product by

ROCKWELL

Rockwell Manufacturing Company

Pittsburgh 8, Pa.

_____Please send complete details on new coated valves.

_____Please send complete details on all Rockwell-Nordstrom valves for corrosive services.

_____Please have your Rockwell field engineer call.

Name:_____Title:_____

Company:_____

Address:_____

City:_____Zone:_____State:_____

Now...for every tube...every size...every type of job

WILSON TORQ-AIR-MATIC

AUTOMATIC EXPANDER DRIVES

for uniform expanding of tubes
MODEL A
for Condensers and Evaporators
¼" to 1¼" O.D.
(marine, power, air conditioning)
Light tube gauges—thin or moderately thick tube sheets
MODEL B
for Heat Exchangers
¾" to 1½" O.D.
(oil refinery—chemical plants)
Small boiler: heavy gauge tubes in thick sheets
MODEL C
for Boiler Tubes
to 3" O.D.
(package and domestic)
2" and 2½" O.D. power plant boiler tubes; re-boiler, waste heat boilers, large tube evaporators, etc.

Now WILSON offers a complete line of Torq-Air-Matic automatic tube expander controls. The Wilson Torq-Air-Matic is the first and only air driven tube expander drive that accurately controls tube expansion by directly measuring torque output at the mandrel without depending on frictional, ratcheting, magnetic, hydraulic or electrical devices.

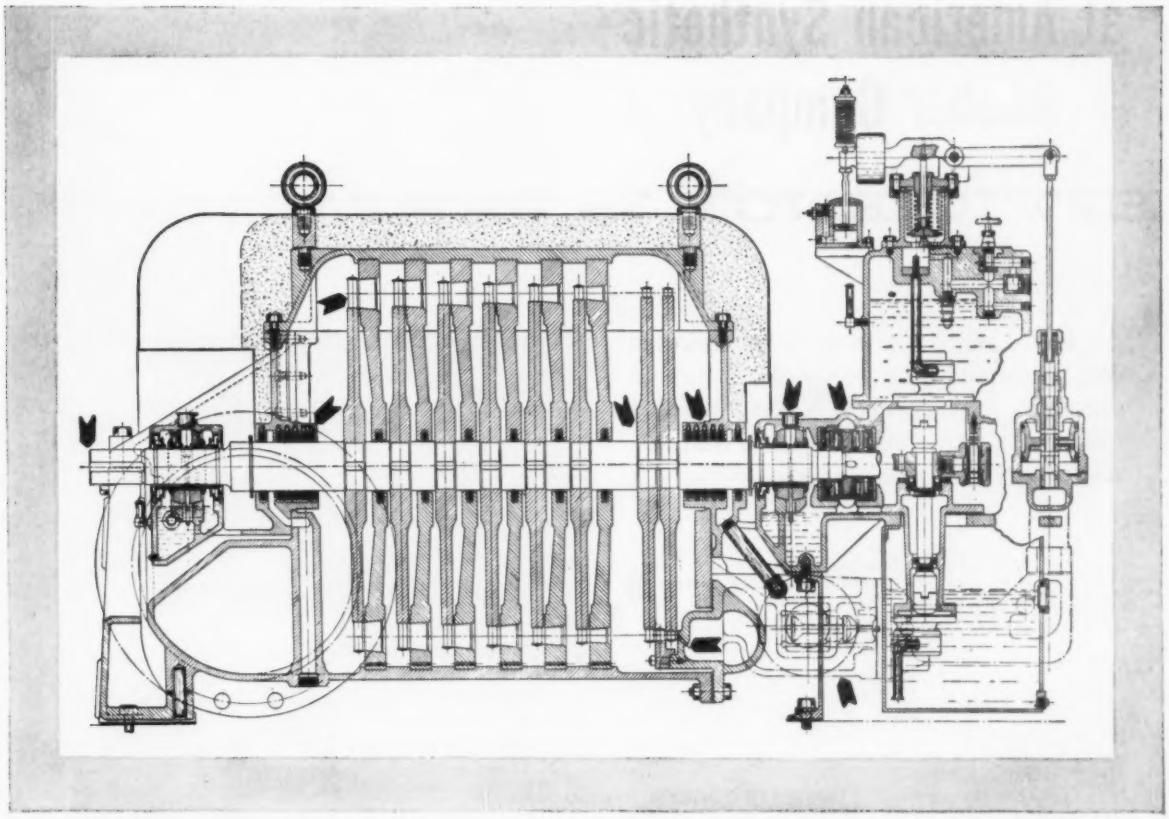
THOMAS C. WILSON, INC. 21-11 44th Ave., Long Island City 1, N. Y.
Branch Office: Land Title Building, Philadelphia 10, Pa.
Representatives in principal cities • Cable Address: "Tubeclean," New York

See how the exclusive design features of WILSON Torq-Air-Matic can help you expand tubes accurately and uniformly with considerable savings in time and manpower. Write for your Bulletin No. 581 which gives helpful data.

TW-887

WILSON

TUBE CLEANERS • TUBE EXPANDERS



ANOTHER INSIDE STORY OF THE UNIVERSAL ACCEPTANCE OF MURRAY MULTI-STAGE TURBINES IN THE MECHANICAL DRIVE FIELD

- Husky accurately machined shaft.
- Discs shrunk and keyed in place.
- Stainless steel nozzles and blading throughout.
- Spherical seated sleeve bearings.
- Kingsbury thrust bearing.
- Center line support.
- Carbon ring gland seals.
- Double seated balanced governor valve — stellited.
- Choice of speed governors from simple mechanical type to precision oil relay.
- Bolt type overspeed trip governor.
- Steam conditions to 600 PSIG and 750°F.
- Condensing or non-condensing.

Our nearest representative will gladly help you solve your mechanical drive turbine requirements. Just write to Murray Iron Works Company, Burlington, Iowa, for his name.

Murray
TURBINES

MURRAY IRON WORKS COMPANY • BURLINGTON, IOWA
Builders of Steam Power Equipment for Nearly a Century

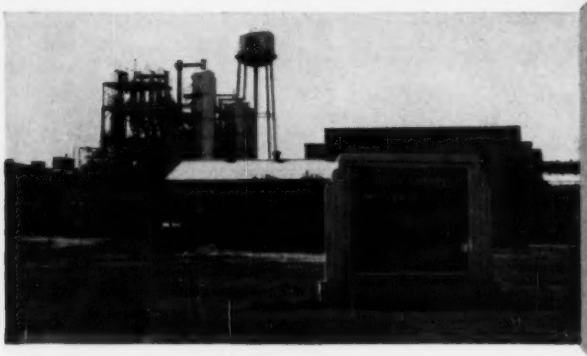
For more data on advertised products, use Readers' Service Cards, last page.

at American Synthetic Rubber Company

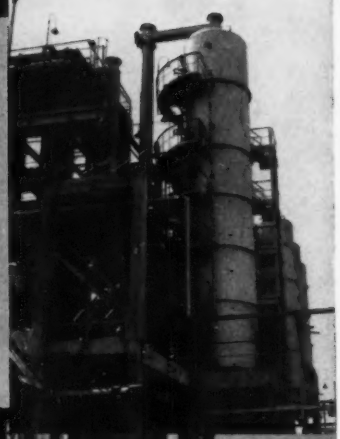
EFFICIENCY IS PARAMOUNT!

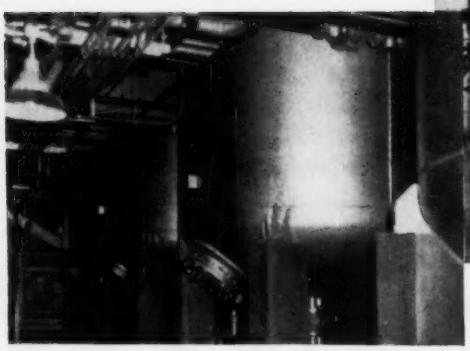
Yes, and for custom plate fabricated code tanks and pressure vessels, there's no substitute for experience. Modern Welding Company is proud to contribute to the progress of successful chemical processors.

Horizontal Latex Blow-Down Vessel
11' ID x 25' TL, ¾" heads, 11/16" shell, 3 manholes, 14 nozzles, 2 sight glasses.



Styrene Stripping Column
10' OD x 50'7" TL, 11/16" heads, ½" shells, 14 internal stainless steel perforated trays, 16 manholes, 15 nozzles, 8 sight glasses.



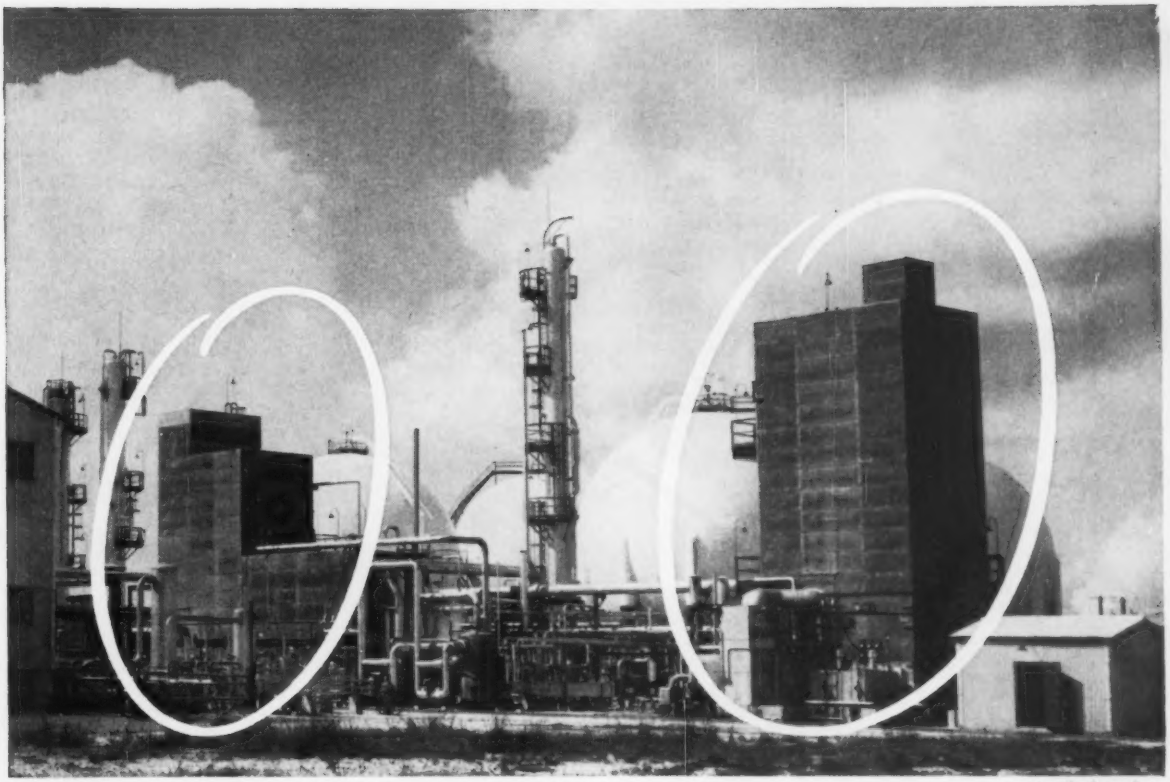


Top and Bottom View, Vertical Latex Blown-Down Vessel
10' OD x 9'6" TL, 7/16" heads, 9/16" shells, 19 nozzles, 3 manholes, 85 WP with full vacuum.

ALL TANKS A. S. M. E. CONSTRUCTED

MODERN TANKS QUALITY

MODERN WELDING COMPANY
INCORPORATED
Owensboro, Kentucky
NEWARK, OHIO • ORLANDO, FLA. • HOUSTON, TEXAS • BURLINGTON, IOWA



Roy Trahan photo

Part of the Petroleum Chemicals Inc. installation at Lake Charles, La., showing the two Air Liquide units mentioned below.

Low-temperature separation at its best!

The large and complex project of Petroleum Chemicals Inc. and Calcasieu Chemical Inc., at Lake Charles, La., is typical of the wide scope and adaptability of low-temperature gas separation.

At the P.C. ammonia producing plant, a raw hydrogen feed stream containing platformer, butadiene, hydroformer and ethylene cracking off gases, is treated by an Air Liquide low-temperature nitrogen scrubbing unit. It is the largest of its kind to handle such a variety of feed streams.

The resulting ammonia synthesis gas, in correct hydrogen-nitrogen ratio and containing less than 20 ppm of total impurities (CO + Oxygen), is rated at the ammonia equivalent of 310 tons per day.

Pure nitrogen for the ammonia and for the liquid nitrogen scrubbing is produced in an Air Liquide air separation plant rated at 100 tons of oxygen per day. Both units will maintain the same product purities even at 60% capacity.

The Calcasieu Chemical plant, with an Air Liquide 180-ton-per-day oxygen unit, uses the gas directly to manufacture ethylene oxide. This unit, differing from the conventional design, is a low-pressure regenerator type producing at the required pressure of 225 psig using liquid oxygen pumps. This special Air Liquide cycle eliminates the problems of oxygen compressors and results in a safe plant with lower power consumption and good process control.

Behind these achievements is more than half a century of design and engineering experience which can help you solve your own low-temperature problems.

Thousands of Air Liquide plants of every type are in use throughout world industry. Here are some of them.

- Air separation—oxygen, nitrogen, and rare gases.
- Coke-oven gas separation.
- Refinery gas separation.
- Methane purification.
- Natural gas liquefaction.
- Pure CO production.
- Heavy water — for atomic reactors.
- Hydrogen liquefaction.
- Helium recovery.

For complete information, write or call

AMERICAN

AIR LIQUIDE

ENGINEERING & CONSTRUCTION DIVISION

OLDEST IN EXPERIENCE — NEWEST IN DESIGN

405 LEXINGTON AVE., NEW YORK 17, N.Y.

In Canada: L'AIR LIQUIDE, 1111 Beaver Hall Hill, Montreal, Que.

In Europe: L'AIR LIQUIDE, 75 Quai D'Orsay, Paris, France.

For more data on advertised products, use Readers' Service Cards, last page.

Now! Ready-to-install in a single package—

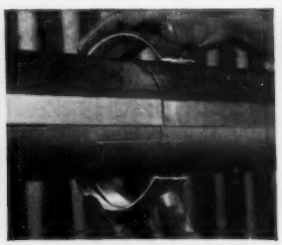
- **High-temperature insulation**
- **A protective metal jacket**
- **A built-in vapor barrier**

The insulation in Metal-On is Johns-Manville Thermobestos® . . . finest of all the calcium silicate insulations for service to 1200°F.

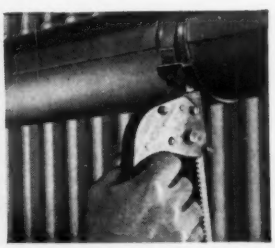
From carton to . . . with

Thermobestos calcium silicate insulation

5 SECONDS TO REMOVE Metal-On from carton. Another 25 seconds to snap on pipe and lock in place!



15 SECONDS LATER the specially designed aluminum "snap strap" (containing vapor seal) has been snapped on joint.



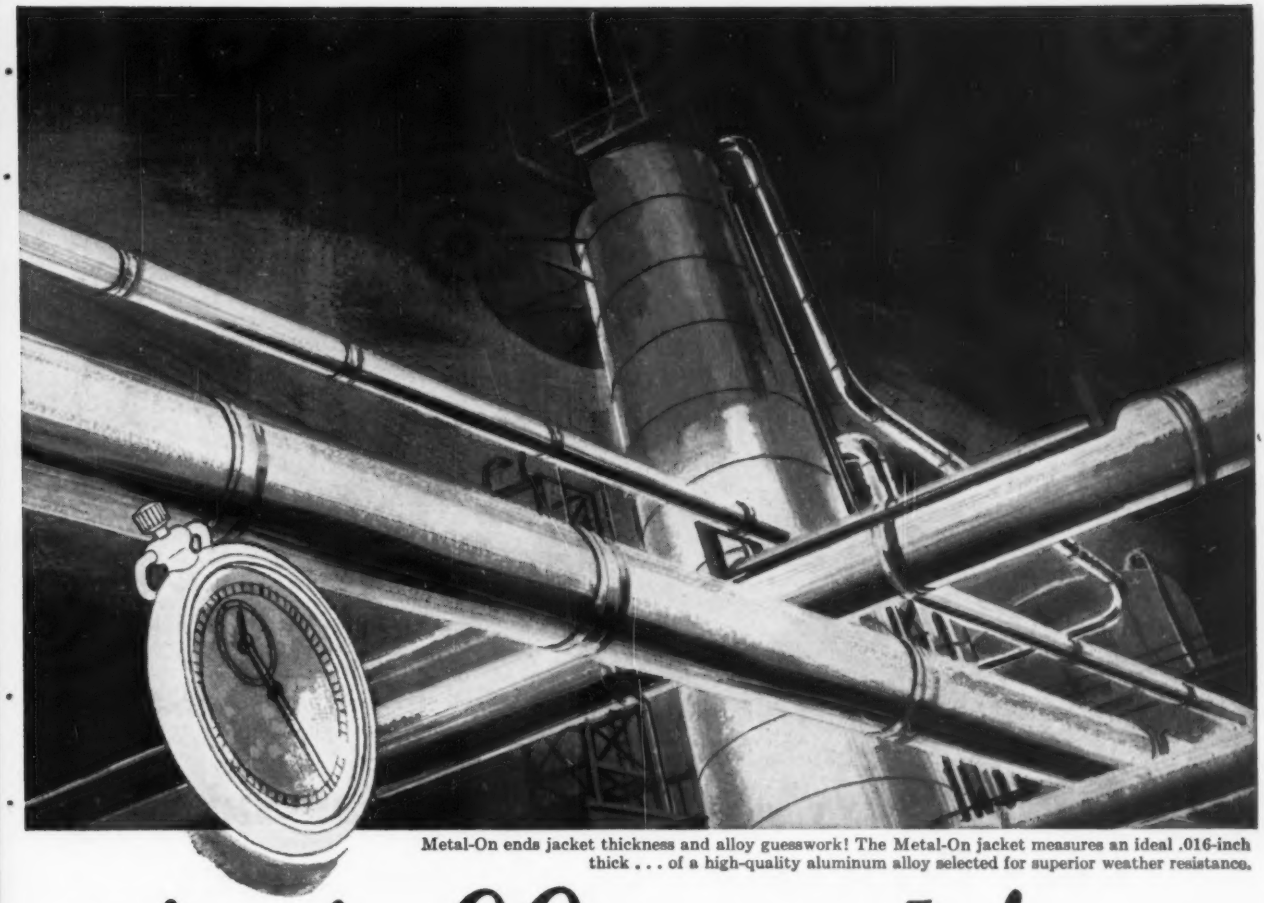
METAL BAND provides perfect joint protection against vapor and weather. Total elapsed time: 90 seconds!

Here's the fastest, most efficient way ever to install high-temperature pipe insulation and protective aluminum jacketing.

Metal-On is the insulation idea all industry has asked for: a single package product that permits application of Thermobestos pipe insulation and corrosion-resistant metal jacket in one fast operation. You'll find that a section of Metal-On can be applied as fast as, oftentimes faster than, an insulation alone.

Snaps in place . . . F-A-S-T!

J-M's new Metal-On consists of Thermobestos calcium silicate insu-



Metal-On ends jacket thickness and alloy guesswork! The Metal-On jacket measures an ideal .016-inch thick . . . of a high-quality aluminum alloy selected for superior weather resistance.

pipe in 90 seconds!

new J-M METAL-ON Insulation!

factory-jacketed in gleaming, weatherproof aluminum

lation, a vapor barrier and an all-weather protective covering of aluminum. Furnished ready-to-install, a section of Metal-On snaps on the pipe, locks tightly in place (new locking device is exclusive Metal-On feature) to seal out weather and protect the insulation indefinitely. Joints are sealed tight with aluminum "snap straps" mechanically fastened in place with metal bands.

Right alloy . . . proper thickness

The Metal-On aluminum jacket reduces maintenance in virtually every outdoor pipe application! It never needs painting . . . won't rust . . . is impervious to surface dirt, oils and grime. The jacketing is made of an aluminum alloy (containing magnesium) that is specially selected for superior corrosion resistance. Jacket thickness is designed to provide, at lowest cost, outstanding appearance, stiffness, workability and resistance to abuse and pitting.

Metal-On presents no fitting problem. It is cut easily right on the job with either power or hack saws. Available in 36″ sections in a complete range of pipe sizes through 24″ . . . by 3″ thickness.

To help you investigate Metal-On for your next pipe insulation requirement, let us send you the informative brochure, IN-217A. Write for it today. Address Johns-Manville, Box 14, New York 16, N.Y. In Canada, Port Credit, Ontario.

JOHNS-MANVILLE

JOHNS-MANVILLE JM PRODUCTS

For more data on advertised products, use Readers' Service Cards, last page.

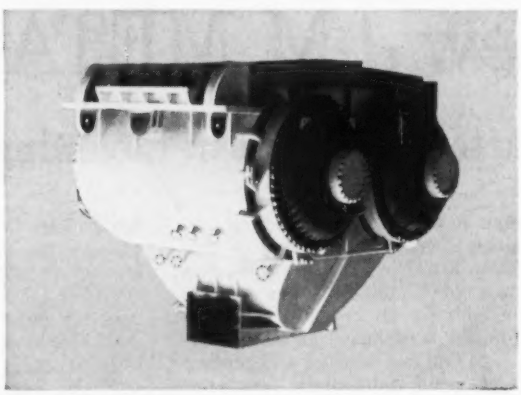
Triton, Navy's Largest Nuclear Sub, Uses Bridgeport Condenser Tubes

Launched in August, 1958, the U.S.S. *Triton* is the biggest, most powerful submarine ever built. With a length of 447 ft. and a displacement of 5,900 tons, *Triton* boasts, among other things, of two engine rooms and two reactor compartments. Built by the Electric Boat Division of General Dynamics Corporation, she is truly a major achievement in naval architecture.

Naturally, *Triton's* equipment must meet the most rigid operating requirements. Helping to fulfill these requirements are Bridgeport Cupro-Nickel condenser tubes in the Allis-Chalmers condenser and air ejector equipment.

Meeting operating demands such as *Triton's* has long been standard practice at Bridgeport. Outstanding operating records have been—and are being—achieved regularly. The experience and knowledge gained from these records can be put to your use—whenever you wish to take advantage of them.

Whatever your needs—simple retubing or other requirements—they are best served, in every respect, by Bridgeport. If you have any problem, question or plans involving heat exchanger equipment, on land or at sea, call your nearest Bridgeport Sales Office. For full details, write direct for the 162-page Bridgeport Condenser Tube Handbook. Write Department 5302.



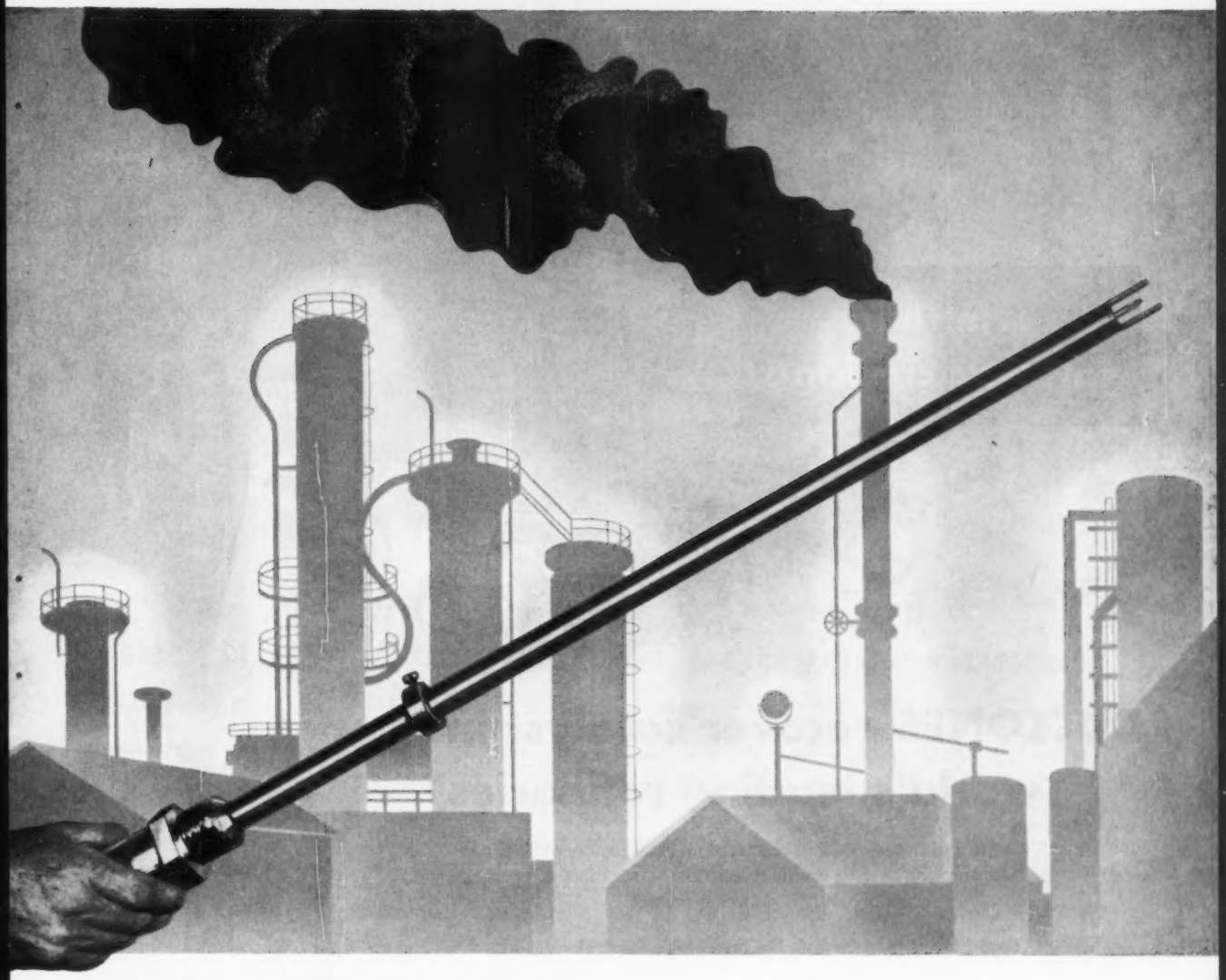
These twin condenser units were designed and built by Allis-Chalmers. Bridgeport tubes were used throughout.

BRIDGEPORT BRASS COMPANY

Bridgeport 2, Connecticut • Sales Offices in Principal Cities

Specialists in Metals from **A***luminum to* **Z***irconium*

Thousands going up the stack?



Reduce Flaring Losses
Control Air Pollution
with the "Anemotherm" Probe-Type Gas Flow Meter

You can stop profits from going up the flare stack with the new "Anemotherm" *Probe-Type* Gas Flow Meter. This *electronic, stainless steel* instrument quickly locates points of loss . . . accurately measures gas flow from 10 to 15,000 FPM with a scale range of 500 to 1. Refineries report savings of thousands of dollars per day.

The new "Anemotherm" Gas Flow Meter offers many exclusive features. Sixteen probe meters can be connected to one strip recorder so that flow in sixteen process lines can be observed and recorded by one instrument. The probe is self-compensating for ambient temperature and can be used in gas streams to 300°F. The probe has fast response, is corrosion resistant and streamlined. Accuracy is ± 5% of meter reading. The "Anemotherm" Gas Flow Meter is easy to install and easy to clean.

Look into the money-saving accuracy and efficiency of the "Anemotherm" Gas Flow Meter. For complete engineering data send for Technical Bulletin 5000.

ANEMOSTAT®

ANEMOSTAT CORPORATION OF AMERICA

10 East 39th Street, New York 16, N. Y.

Representatives in Principal Cities

AC1369

. . . in fluid catalytic cracking

DUCLONES® recover catalyst in world's leading refineries

Control of catalyst dust in reactors and regenerators of fluid catalytic cracking units is essential from the standpoints of operating efficiency, economy and air pollution control.

Type SDC Duclones and Ducon Dip-Leg Trickle Valves offer the ultimate in catalyst recovery systems. They have earned the enthusiastic approval of the world's leading refineries because of their consistently high efficiency, low pressure loss and long service life under high temperature and erosive conditions. Type SDC Duclones are available in a wide range of materials, sizes, plate thicknesses and multiple groupings. They can also be supplied lined with a refractory material.

Send today for Bulletins C-2058 and V-1458.

Photo courtesy Tidewater Oil Co.

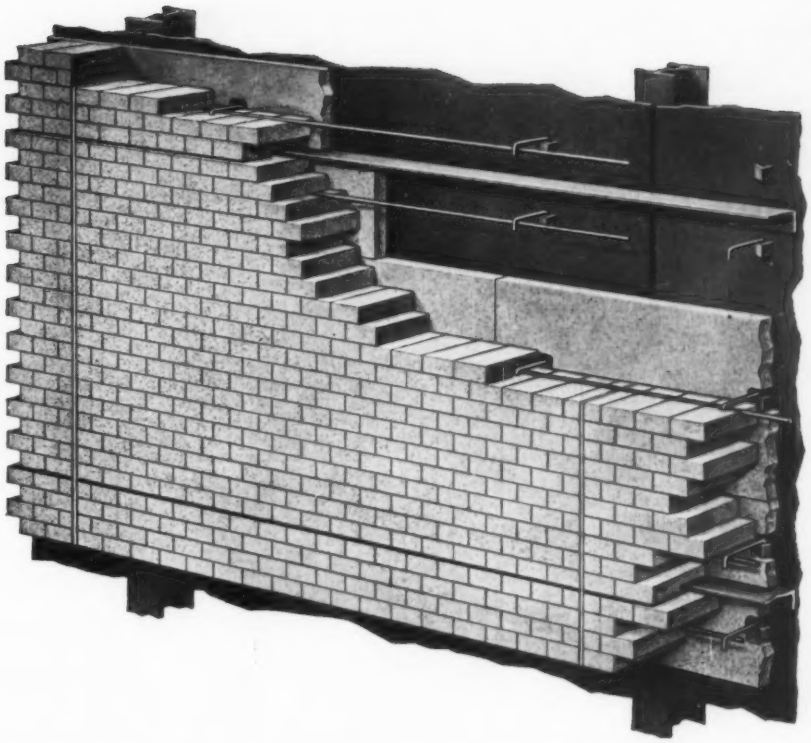
DUCON — DUST CONTROL SYSTEMS AND EQUIPMENT

the name in DUst CONtrol

THE Ducon COMPANY INC.
147 EAST SECOND STREET • MINEOLA, L. I., NEW YORK

Canadian Branch:
THE DUCON COMPANY of CANADA, Ltd.,
1131 Pettit St., BURLINGTON, ONTARIO

CYCLONES • CENTRIFUGAL WASH COLLECTORS • TUBULAR CLOTH FILTERS • DUST VALVES



B&W Insulating Firebrick sectionally supported wall construction, horizontal rod-type anchoring

Can this construction cut your costs?

Simplified design and lower material costs in initial construction, ease of installation and maintenance, reduced downtime and economy of operation—these are the benefits of this *lightweight* insulating firebrick construction.

Here's what lightweight means. Compared with dense fireclay refractory materials that weigh from 125 to 140 lb per cu ft, lightweight insulating firebrick weigh approximately 26 lb per cu ft for B&W's 2000 degree brick. This difference provides two major advantages: (1) mechanical, which largely affects design and construction, and (2) thermal, which saves in maintenance, downtime and operation.

Savings in design and construction

The use of lightweight IFB simplifies engineering requirements and reduces costs. A minimum of detailing is needed, since the design is engineered around one standard shape — a feature of B&W IFB constructions.

Material requirements are simplified, too. B&W IFB can be tailor-cut, drilled or shaped as necessary, eliminating the need for costly special fired shapes, and the delays in obtaining them. Typical sections, such as burner openings, observation ports and tube supports, can be cut and shaped on the job in minutes, using ordinary woodworking tools.

Substantial savings are possible in structural steel, since insulating firebrick roof and wall constructions are lighter. In locations with soil of poor load bearing capacities, this lightweight may also result in reduced foundation costs.

These savings, coupled with B&W's engineering and service facilities available during the design phase, mean lower initial costs.

Savings in maintenance, downtime and operation

Lightweight IFB offer a major thermal benefit—they store and conduct less heat. Heavy refractories retain heat; in the event of forced shutdown, they can cause burn-out of expensive alloy tubes, where used. The low quantity of heat stored by B&W IFB can be quickly dissipated, thus protecting these expensive tubes.

Further, this low heat storage permits faster heating and cooling. This means quicker access to the furnace in the event of emergency shutdown. Your maintenance crew can get in the furnace sooner and get it back on stream faster.

Supplied from nearby warehouses

With the use of simplified IFB constructions, refractory repairs can be quickly and easily accomplished with standard shapes from a nearby warehouse. This eliminates costly delays in obtaining special shapes.

Anchoring devices, too, are simplified. Since there are no expensive special castings in B&W IFB constructions, carbon steel or low alloy rods can be used. These are generally available from any local steel warehouse.

Increased efficiency

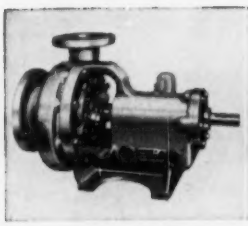
Generally, the lighter a firebrick the better an insulator it is. Since B&W IFB are the lightest insulating firebrick made, they are the most efficient insulators. Per inch of thickness, B&W IFB provide more insulation than any other refractory material. The result is that for walls of equivalent thickness less heat is lost with B&W IFB. Casing temperatures are lower, thus improving working conditions. This means increased efficiency and reduced operating costs.

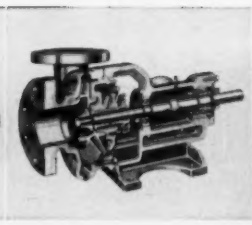
R 530

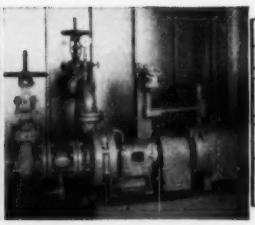
BABCOCK & WILCOX

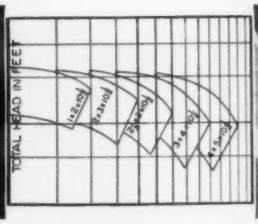
THE BABCOCK & WILCOX CO.
REFRACTORIES DIVISION
GENERAL OFFICES: 161 EAST 42nd ST., NEW YORK 17, N.Y.
WORKS: AUGUSTA, GA.

For more data on advertised products, use Readers' Service Cards, last page.









BECAUSE...

PEERLESS CHEMICAL PUMPS:

MEET critical standards of construction, you benefit from longer pump life, less maintenance, and sharply reduced incidence of system shut down caused by pump failure. Top quality Peerless construction means a dependable, rugged pumping unit you can count on to stay on the job for years longer.

PROVIDE proved operating history, you benefit from the knowledge that you're not buying a pump in the dark. Analysis by Peerless of customer pump operating records allows continuous product improvement. Correlation of this data provides Peerless with answers to nearly all field pumping problems.

OFFER optimum performance range, you benefit from the economical performance only the exact pump for the job can give you. The Peerless process pump line of over 78 models, sizes and frames, plus thousands of combinations, assures you of pinpoint pump selection that effects direct savings in cost.

EMBODY benefits of research in all areas of design, construction, and application. Typical of the many considerations in the design and manufacture of a Peerless pump is the ascertaining of effects of radial loads. **An interesting 8 page booklet discussing this phase of pump design is available to you upon request.**

Engineers and Pump buyers say:

"PEERLESS PUMPS IT BEST!"

...buy and apply PEERLESS PUMPS

Putting Ideas to Work

fmc FOOD MACHINERY AND CHEMICAL CORPORATION

Peerless Pump Division

Plants: LOS ANGELES 31, CALIFORNIA and INDIANAPOLIS 8, INDIANA

Offices: New York; Atlanta; St. Louis; Phoenix; San Francisco; Chicago; Fresno; Los Angeles; Plainview and Lubbock, Texas; Albuquerque.

Distributors in Principal Cities. Consult your telephone directory.

For more data on advertised products, use Readers' Service Cards, last page.

Blaw-Knox uses a Royal Electronic Computer to speed material balance and energy calculations and to aid in equipment design. The Royal LGP-30 computes optimum design conditions for projects handled by the engineering, chemical process, and equipment design departments.

Blaw-Knox adds electronics to experience to solve your design-engineering problems

With electronic computation Blaw-Knox has again broadened the scope of its services . . . to explore and solve your process and engineering problems with new speed, new precision, and new economy.

With this time-saving tool, Blaw-Knox engineers can accurately examine and solve complex problems heretofore considered impractical to answer with precision. Your project's needs and their solution get new scrutiny. Optimum conditions are attained to give you a plant that's more economical to build, more profitable to run.

When you plan your next advanced process design, plant construction, expansion, or modernization, contact Blaw-Knox Company, Chemical Plants Division with headquarters in Pittsburgh. Branch offices in New York, Chicago, Haddon Heights, New Jersey, Birmingham, Washington, D.C., and San Francisco.

plant builders for industry . . BLAW-KNOX

For more data on advertised products, use Readers' Service Cards, last page.

This centrifugally cast Reformer Tube with argon shielded weld is stronger than any wrought tube

X-ray inspection of weld

Thermalloy® Reformer Furnace Tubes are centrifugally cast in sections to specified diameters . . . to insure greater strength and density, finer grain structure and uniform thickness.

Individual tubes are given air and hydrostatic pressure tests. Weld quality is guaranteed by fluid penetrant and X-ray inspection. Complete assemblies receive another air and hydrostatic test. These tests provide protection against premature weld failures and against leaks at temperatures of 1800°F. and pressures exceeding 150 psig.

Electro-Alloys sales engineers can help you to select the grade of heat-resistant Thermalloy best suited to your particular operating conditions. Call your nearby representative, or write Electro-Alloys Div., American Brake Shoe Company, 1033 Taylor Street, Elyria, Ohio.

AMERICAN Brake Shoe COMPANY

ELECTRO-ALLOYS DIVISION • Elyria, Ohio

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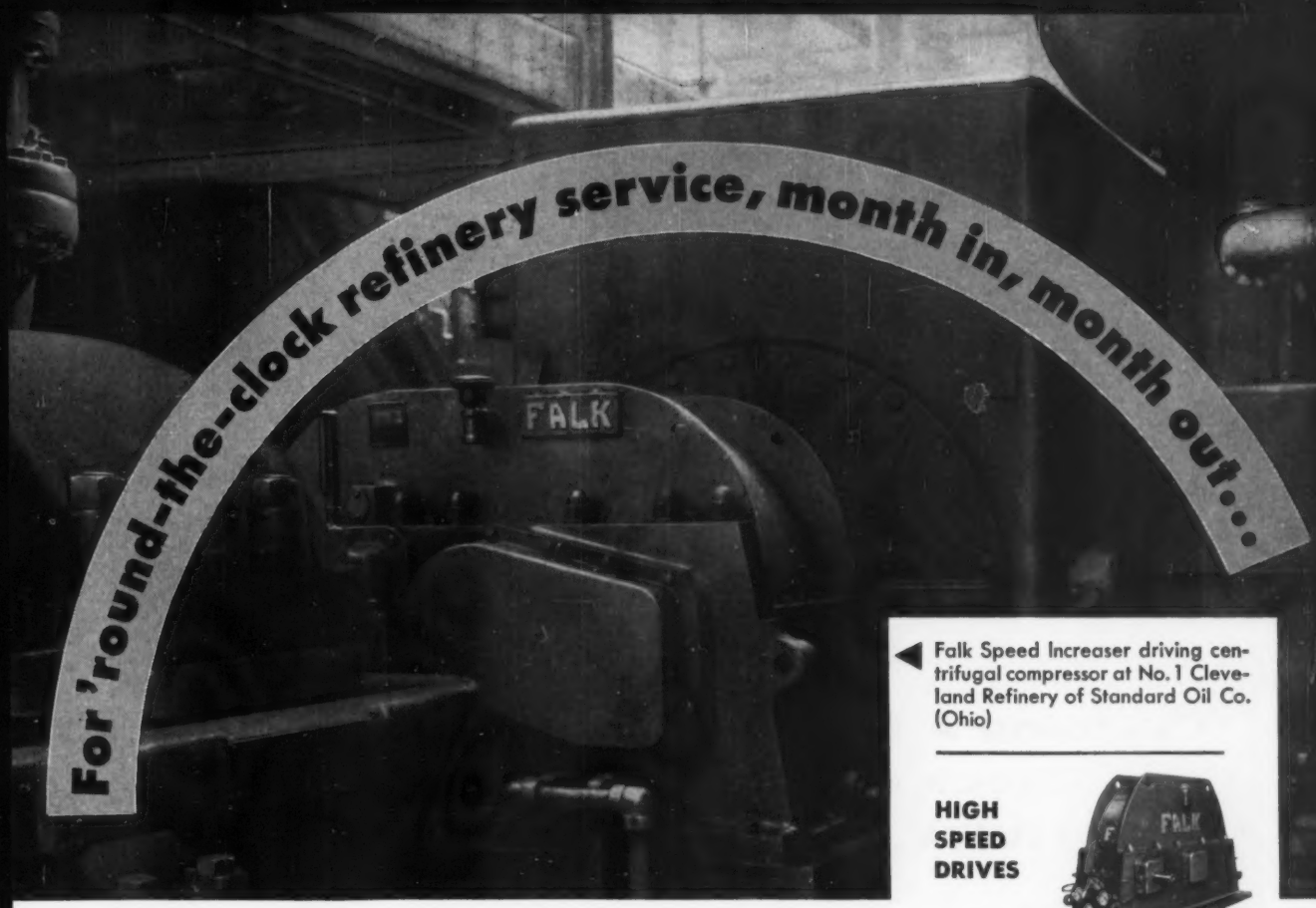


◀ Falk Speed Increaser driving centrifugal compressor at No. 1 Cleveland Refinery of Standard Oil Co. (Ohio)

FALK offers a complete line of standard high speed and semi-high speed drives

type P Ratios—from 2.5:1 to 12.0:1.
Horsepower—up to 2000 hp per 1000 rpm of high speed shaft.
Maximum speed of high speed shaft: 10,000 rpm.

type Q Ratios—from 1.15:1 to 9.5:1.
Horsepower—up to 1800 hp per 1000 rpm of high speed shaft.
Maximum speed of high speed shaft: 10,000 rpm.

type H Ratios—from 2.22:1 to 9.89:1.
Horsepower: up to 1100 hp.
Maximum speed of high speed shaft: up to 3600 rpm.

type S Ratios—from 1.49:1 to 25.4:1.
Horsepower—up to 224 hp.
Maximum speed of high speed shaft: 4500 rpm.

SPECIAL DRIVES...to any required speed and horsepower.

• • • • •

Designed and produced by the Falk engineers who pioneered the ultra-high speed gear units for aviation turbo engine test facilities, Falk standard high speed drives are widely used in refineries throughout the country. Our technicians will be glad to work with your engineers or with your equipment suppliers to select and produce drives precisely suited to your operation.

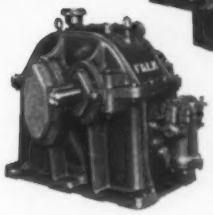
FALK is a Registered Trade Mark.

THE FALK CORPORATION, MILWAUKEE 1, WISCONSIN

MANUFACTURERS OF QUALITY GEAR DRIVES AND FLEXIBLE SHAFT COUPLINGS

Representatives in Most Principal Cities

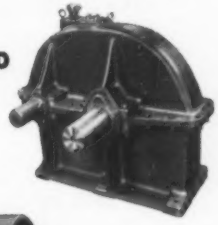
HIGH SPEED DRIVES

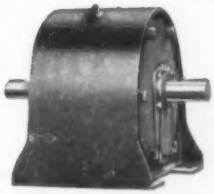


type P

type Q

SEMI HIGH SPEED DRIVES



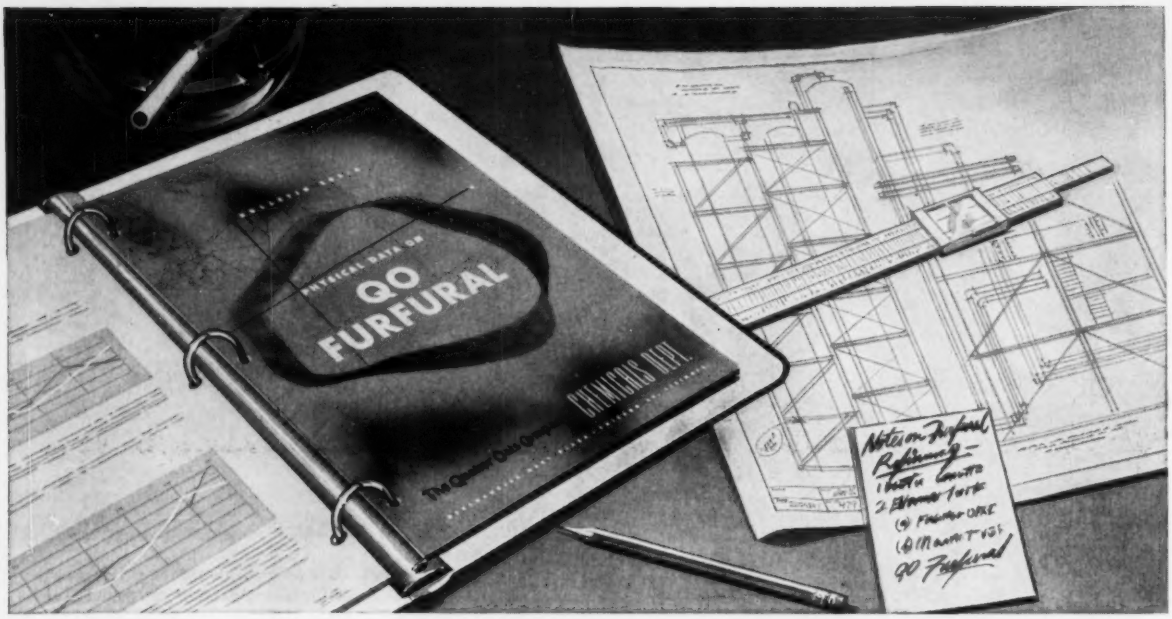


type H

type S

FALK

...a good name in industry



Planning A New Solvent Refining Unit? Check into QO® FURFURAL for SELECTIVITY, FLEXIBILITY and ECONOMY

QO FURFURAL'S Sharp Selectivity

QO Furfural is a polar molecule and gives sharp separation of saturates from unsaturates in lube oils, gas oils, cycle stocks and other petroleum products. Furfural is equally selective in the extractive distillation of C_4 hydrocarbons to give high purity butadiene. It is even effective in the separation of organic sulfur compounds or heavy metal complexes from petroleum fractions.

QO FURFURAL'S "Three-in-One" Flexibility

One furfural unit can be used to refine lube oil, gas oil or cycle stock as product demand indicates. In all of these operations, QO furfural performs with excellent efficiency.

QO FURFURAL'S Dual Economy

Low price plus operational savings—that's the double economy of refining with QO furfural. You can recover easily over 99.95% of the furfural circulated. The recovery is so good that much of the furfural makeup required is due to mechanical losses. The high thermal stability of furfural permits long continuous operation between "turn arounds."

These are some of the reasons leading companies have included QO furfural in their plans. Get facts for your planning by writing for Bulletin 203-A entitled "Physical Data on QO Furfural."

The Quaker Oats Company

CHEMICALS DIVISION

The Quaker Oats Company — CHEMICALS — QO — QUAKER CHEMICALS — DIVISION

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In Japan:
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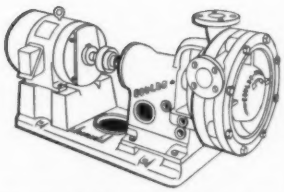
IS THIS HAPPENING INSIDE YOUR PUMPS?



The Goulds-Pfaudler glassed pump is available in conventional hydraulic design, simplifying installation and maintenance. Four sizes with capacities up to 700 GPM, heads up to 140 ft.

When you pump corrosives, the inside of your pump *can* look like this. Or . . .

You can pump corrosives *without* corrosion with the Goulds-Pfaudler Fig. 3708 glassed pump. *Every surface that comes in contact with the pumpage* is protected by tough borosilicate glass fused permanently to the metal!

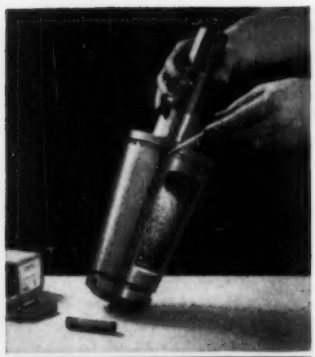
This glass-to-metal bond resists most acids at temperatures up to 350°F and alkalies at moderate temperatures.

You also prevent loss of product due to contamination, since glass is *inert*. Glass is *smooth*—discourages product adhesion and scale build-up.

For all the details, write for Bulletin 725.2 . . . plus a second booklet, "It's What's Inside That Counts," that gives you the inside story behind the new Goulds-Pfaudler glassed pump. Write Goulds Pumps Inc., Dept. PR-39, Seneca Falls, New York.

GOULDS GP PUMPS

For more data on advertised products, use Readers' Service Cards, last page.

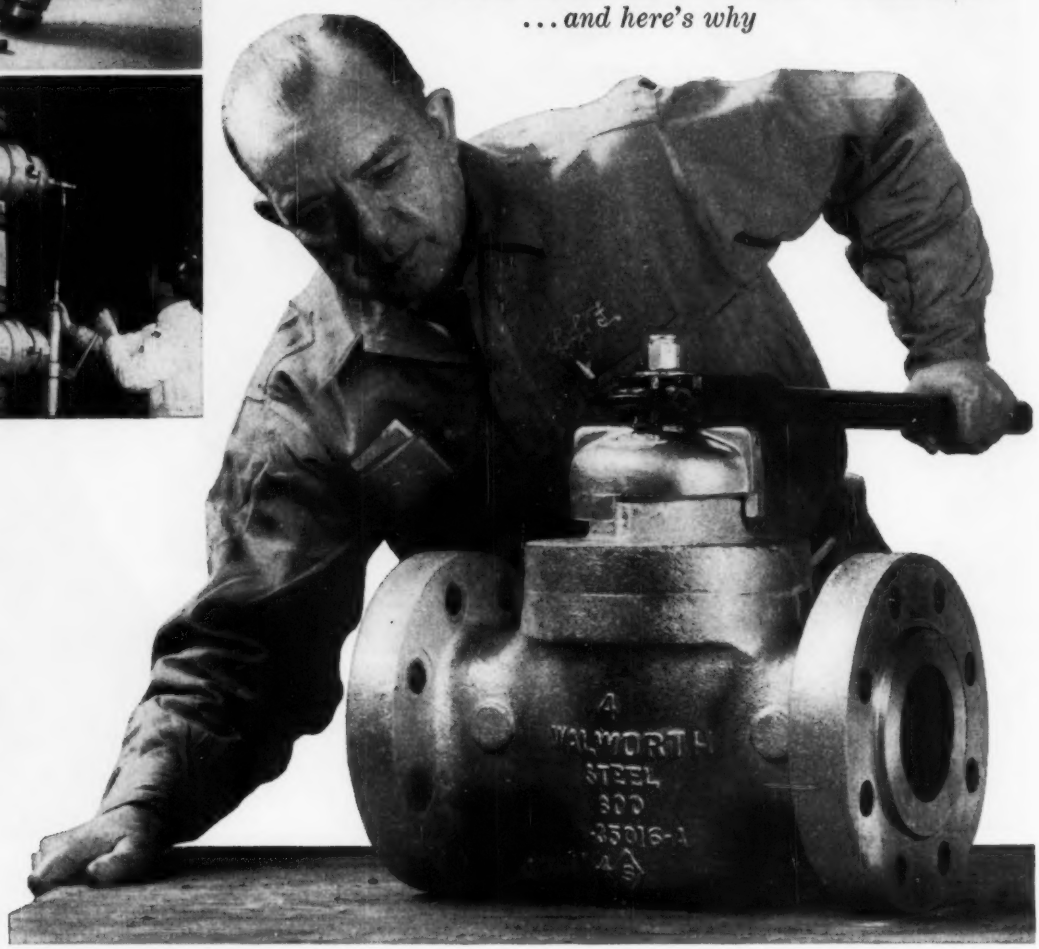


the **WALWORTH CUSTOMER**

wants a quick operating, sure, tight valve. He chooses a

WALWORTH LUBRICATED PLUG VALVE

. . . and here's why



When the Walworth Customer has to decide on a valve that will close fast and easily, he wants to know HOW fast . . . HOW easily. Tight closure? Of course. But can the valve be serviced under pressure? Yes. Still, he tries one himself.

In the Walworth Lubricated Plug Valve he finds 100% tight closure because it is lubricant-sealed against leakage. He finds it opens or closes with a quarter turn. Then, and only then, he's ready to buy. If that's the way you like to buy valves, we want you, too, for a Walworth Customer. For details on all types and ratings of Walworth Lubricated Plug Valves, ask your Walworth Distributor.

Or write **WALWORTH** *750 Third Avenue, New York 17, N. Y.*

DISTRIBUTORS IN PRINCIPAL CENTERS THROUGHOUT THE WORLD

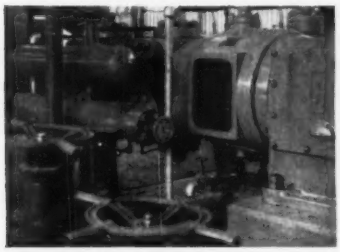
WALWORTH SUBSIDIARIES: ALLOY STEEL PRODUCTS CO. • CONOFLOW CORPORATION • GROVE VALVE AND REGULATOR CO. M&H VALVE & FITTINGS CO. • SOUTHWEST FABRICATING & WELDING CO., INC. • WALWORTH COMPANY OF CANADA, LTD.

For more data on advertised products, use Readers' Service Cards, last page.

Pointer oscillation only a minor reason for dampening of industrial thermometers

It is generally assumed that industrial thermometers are silicone dampened solely to prevent pointer oscillation when used on vibrating equipment. True, the prevention of pointer oscillation is necessary, but actually there are several far more important reasons for the use of silicone dampening fluids.

The primary reason for dampening bimetallic dial thermometers is to preserve accurate calibration, especially on the lower temperature ranges where a thinner bimetal element is used. An *un*dampened bimetal element, when subjected to shock or severe vibration, would have a tendency to unwind slightly, throwing the instrument out of calibration. To prevent this, thermometers are dampened by covering the bimetal element with silicone fluid. The silicone provides permanent protection for the critical bimetal element, holding the coil in place and preventing any unwinding or shifting action. This dampening, of course, also prevents pointer oscillation, eliminating difficult readings. But the primary reason for silicone dampening is to help maintain calibration accuracy, and it is therefore quite important to *all* industrial thermometer users.



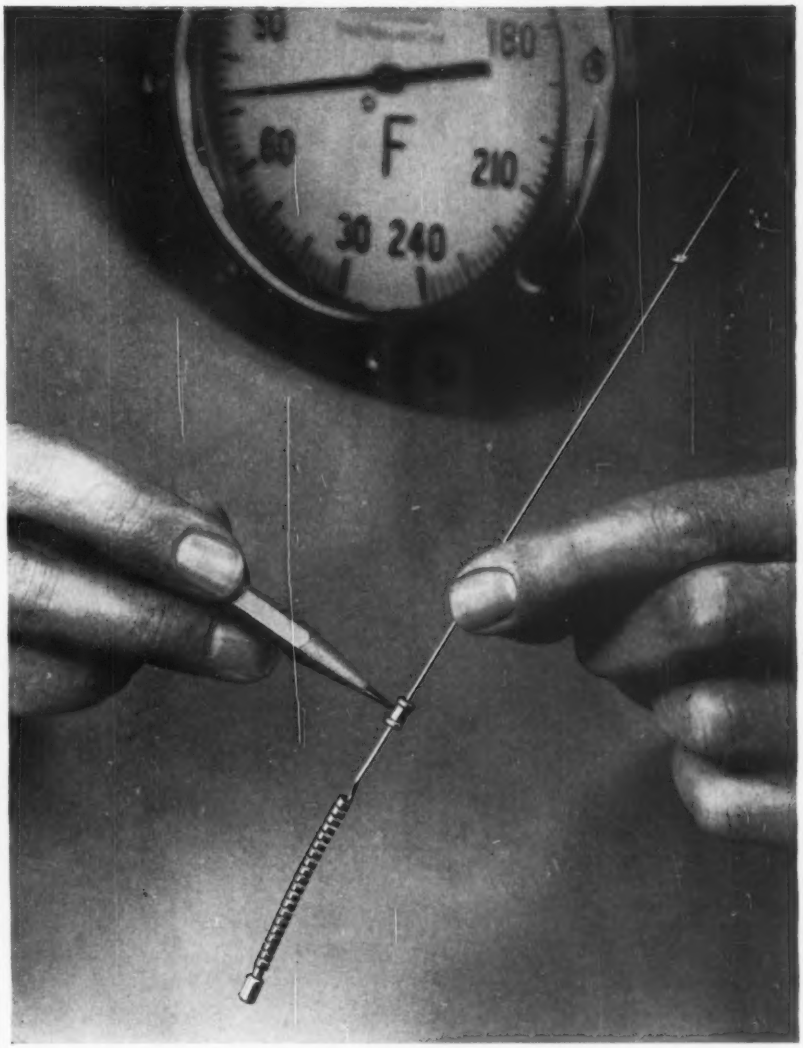
The RMC thermometer in this photograph is constantly subjected to extreme vibration. It is installed on a two-stage Synthesis Gas Compressor in Atlantic Refinery's Philadelphia Synthetic Ammonia Plant. Only a completely dampened thermometer could maintain its accuracy under such conditions.

There is more, however, to the full dampening story. Rochester Manufacturing Company carries this dampening procedure one step further with a specially designed bearing which further dampens both the shaft and coil. It also serves as a better guide for the bimetal shaft to keep it perfectly aligned within the tube. RMC is the only manufacturer using this type of dampening bearing at the present time.

RMC offers compensated electrical remote-reading liquid level indicator

A double coil movement in the RMC electrical, remote-reading liquid level indicator compensates for voltage changes. Silicone dampened and hermetically sealed.

Write, wire or phone—tell us your requirements for indicating instruments, and let RMC engineering skill go to work for you. ROCHESTER MFG. CO., 38 Rockwood St., Rochester 10, N. Y.



This special dampening bearing goes one step beyond silicone in the dampening of RMC thermometers. Only RMC uses this *extra* dampening device in addition to silicone and the usual stamped guide bearings. It is a precision machined part, serving several needed dampening functions.

Special bearing *plus* silicone double-dampens RMC thermometers

In RMC bimetal thermometers a specially designed dampening bearing is used just above the bimetal element. This bearing further dampens the shaft, helps to prevent coil unwinding and pointer oscillation, and also serves as a better guide for perfect shaft alignment within the tube. It's the combined use of this dampening bearing *and* silicone that makes RMC thermometers extra resistant to shock and vibration. You get this *only* in RMC industrial thermometers.

RMC

ROCHESTER MANUFACTURING CO., INC.
38 ROCKWOOD STREET • ROCHESTER 10, N.Y.

LIQUID LEVEL, TEMPERATURE and PRESSURE INSTRUMENTS

REPRESENTATIVES IN ALL PRINCIPAL CITIES

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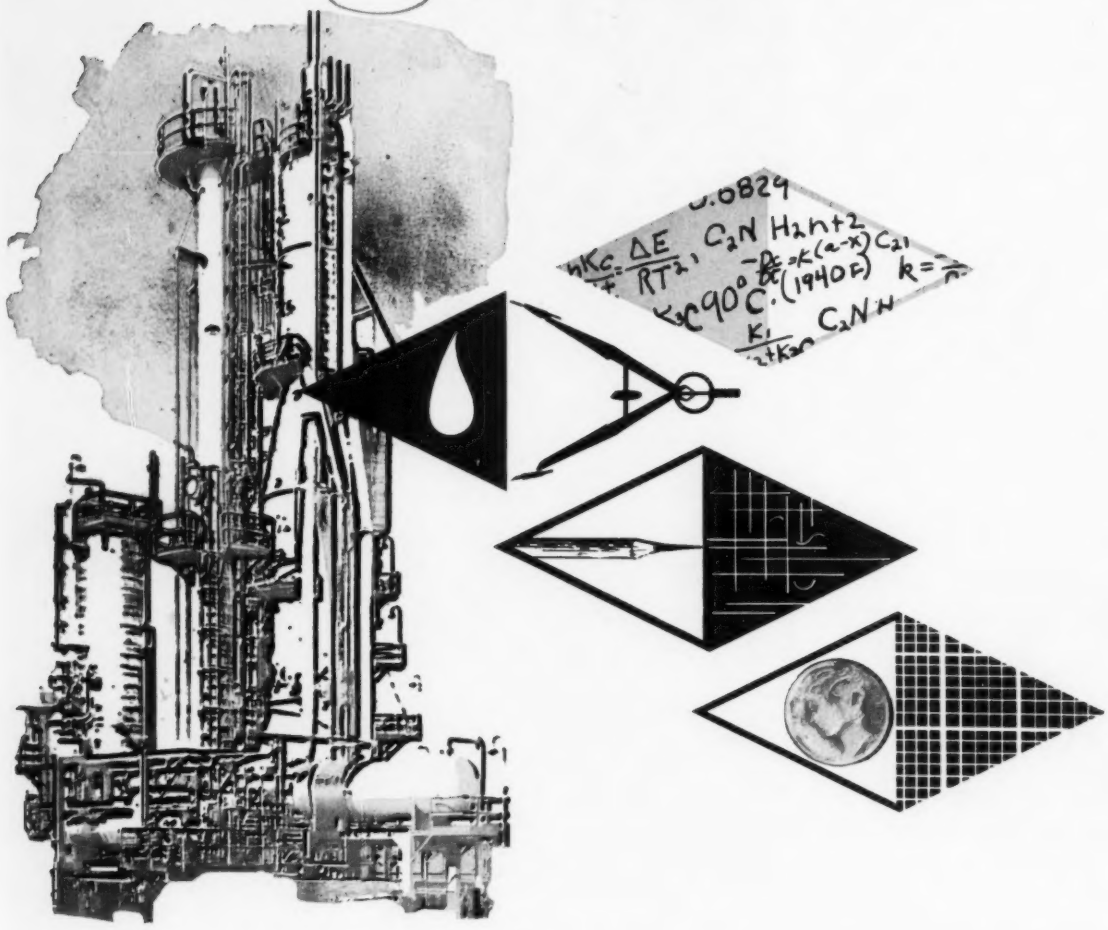
intangibles were never so important



PRECISION CONSTRUCTION

Worker recruiting and training . . . special safety programs . . . on-the-spot solutions to pressing problems . . . these and other extras are included in Procon service. Applying such intangibles to construction of petroleum, chemical and petrochemical plants is the specialized function of Procon. Modern, efficient construction techniques form but a part of the precision construction system developed by Procon. That is why a Procon-built plant can be depended upon to more than meet specifications.

PROCON®

PROCON *Incorporated*

1111 MT. PROSPECT ROAD, DES PLAINES, ILLINOIS, U.S.A.

PROCON (CANADA) LIMITED, TORONTO 18, ONTARIO, CANADA

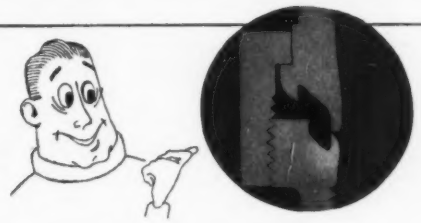
PROCON (GREAT BRITAIN) LIMITED, LONDON, W. C. 2, ENGLAND

PROCON INTERNATIONAL S. A., SANTIAGO DE CUBA

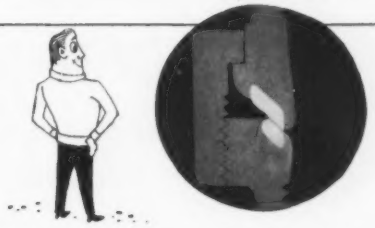
WORLD-WIDE CONSTRUCTION FOR THE PETROLEUM, PETROCHEMICAL, AND CHEMICAL INDUSTRIES

Rocky spots the advantages of color-coded Rockwood Unions

Color-coding makes identification easy for warehouse personnel and pipe fitters

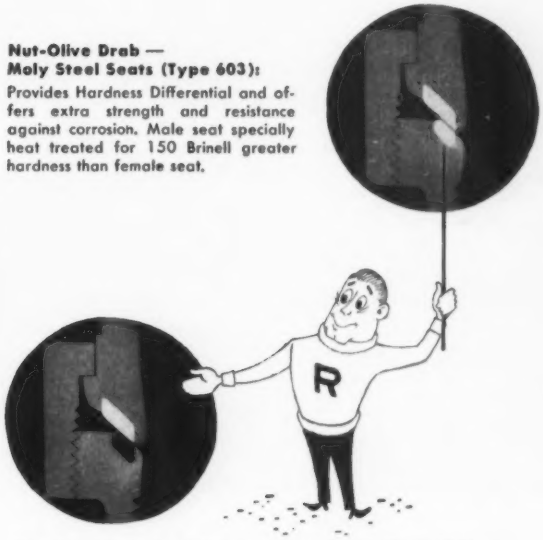


Nut-Gray — 2 Silicon Bronze Seats (Type 601):
These seats prevent corrosive action, electrolytic action, and dezincification of seat joint. Silicon bronze withstands much higher temperatures than ordinary bronze or brass — *perfect for chemical, steel, rubber, paper, and textile industries.*



Nut-Black — 2 Stainless Steel Seats (Type 602):
For use with *carbon steel pipe* and where there are severe temperature or acid conditions — but where an all stainless steel installation isn't necessary.

Nut-Olive Drab — Moly Steel Seats (Type 603):
Provides Hardness Differential and offers extra strength and resistance against corrosion. Male seat specially heat treated for 150 Brinell greater hardness than female seat.



Nut-Gray — Moly to Silicon Bronze Seats (Type 604):
Combines advantages of Types 601 and 603. Specially adaptable for shipboard use.

You get all these advantages too—

All parts are completely interchangeable. Rockwood Cold Forged Steel Unions will not gall in "making up" because the male seat is 150 Brinell harder than the female seat. This is the Hardness Differential you *need* in replacement and new work.

Rockwood Unions meet all general piping requirements. They are highly corrosion-resistant and are sold off standard Black Steel price list. Packed in cartons for palletizing. All Unions are tested and listed by Underwriters' Laboratories, Inc. Write for complete information today.

ROCKWOOD SPRINKLER COMPANY

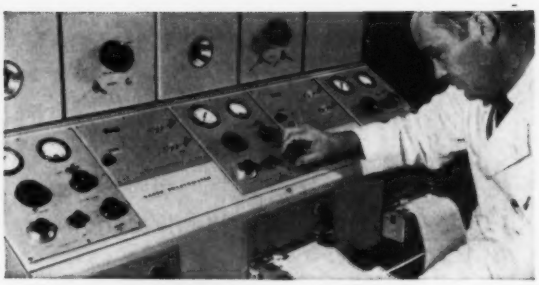
Distributors in all principal industrial areas

ROCKWOOD SPRINKLER COMPANY
2829 Harlow Street
Worcester 5, Massachusetts

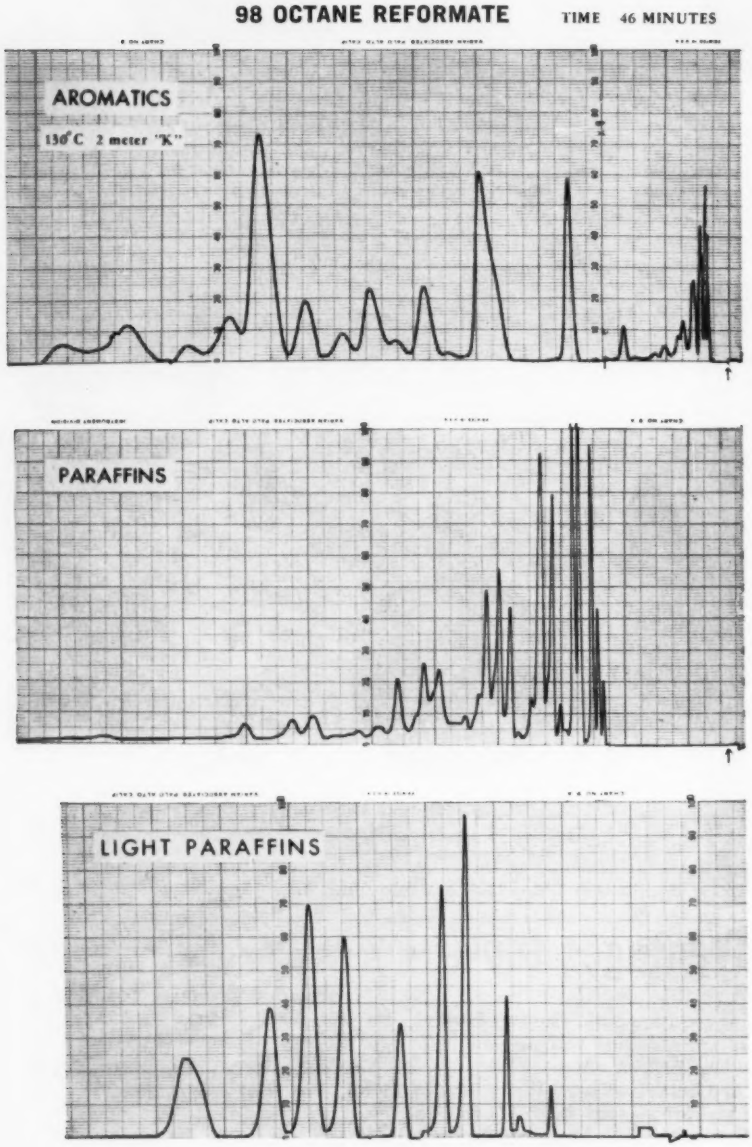
Please send me further information on Rockwood Unions.

Name .....
Title .....
Company .....
City .....
Zone ..... *State* .....

For more data on advertised products, use Readers' Service Cards, last page.



MULTI-STAGE VPC ANALYZES COMPLEX PETROLEUM FUELS IN LESS THAN AN HOUR



Perkin-Elmer's new Model 188 triple-stage vapor fractometer surpasses any current single-stage gas chromatographic instrument, affording a completely new dimension of versatility which was not previously attainable.

38 Components—46 Minutes

Analysis by the Model 188 of a typical 98-octane reformate sample (see illustration) will illustrate the capabilities of the instrument in the petroleum refining field.

Polyethylene glycol was selected for the first stage column. Its characteristics are such that the most volatile aromatic, benzene, is retained about as long as the least volatile n-paraffin, n-decane. This column therefore produces a separate record of aromatic content. Other components are passed to the second column, for which β-β' oxydipropionitrile was chosen. This material gives excellent separation of medium range paraffins and cycloparaffins.

The third stage provides ultimate separation of the lightest components of the mixture. Squalane was the stationary phase used here.

In total, thirty-eight resolved bands, plus evidence of at least ten partially resolved bands, can be seen.

Complete details on the analytical applications of the Model 188 in the petroleum field will be found in a paper[1] delivered by three Perkin-Elmer chromatographers, reprints of which are available. Write us at 880 Main Avenue, Norwalk, Connecticut.

1. "Analytical Applications of a Triple Stage Gas Chromatography Instrument"—N. Brenner, L. O'Brien, V. J. Coates. Presented at the 1958 Pittsburgh Conference.

INSTRUMENT DIVISION
Perkin-Elmer *Corporation*
NORWALK, CONNECTICUT

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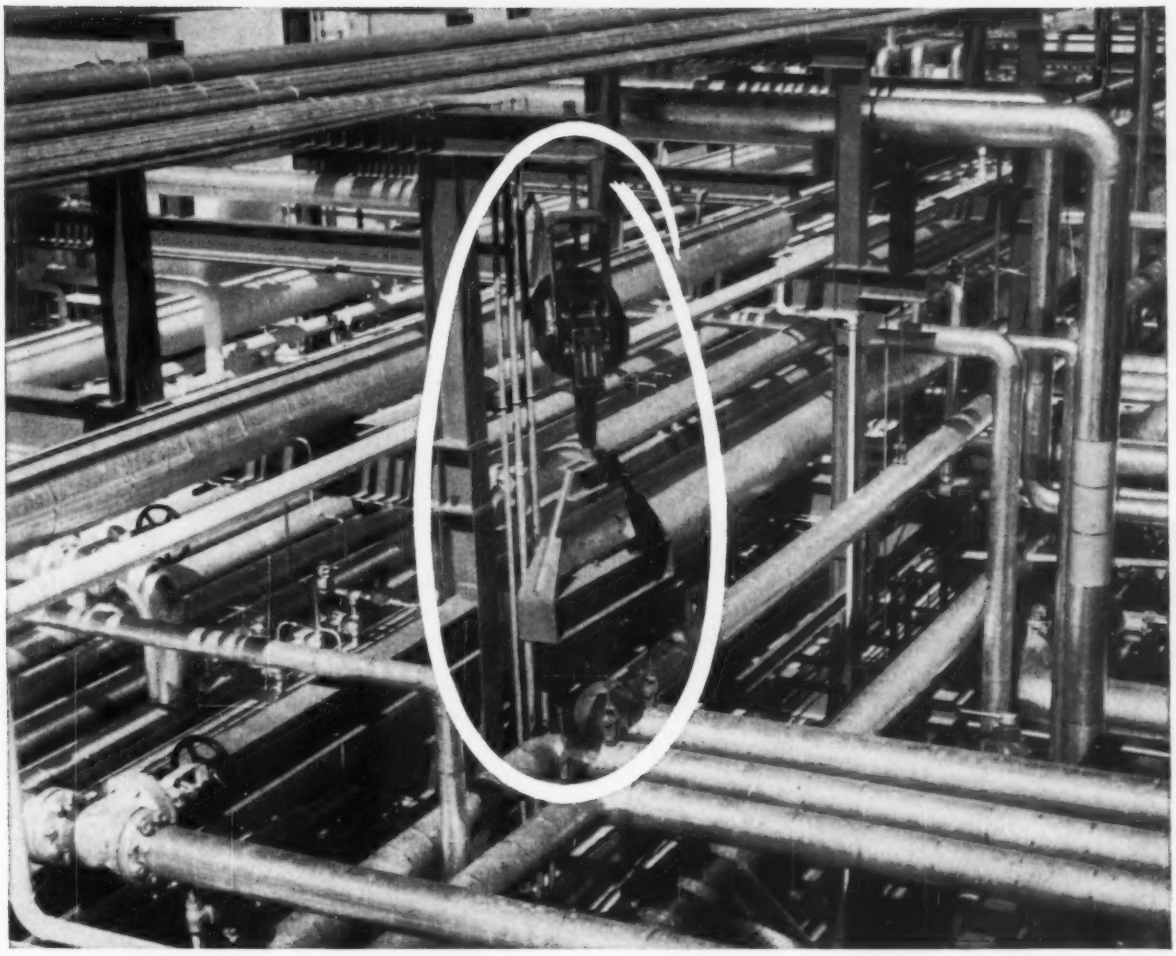
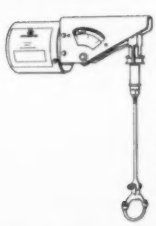


This unusual pipe suspension problem was solved by Grinnell with hangers out of stock

When Grinnell was called in by El Paso Natural Gas Company to handle an unusual pipe suspension problem created by thermal expansion, not one . . . but two problems had to be solved. First, there was an overall vertical pipe movement of 11.6″ to be contained. And second, each of 3 different lines, operating at 3 different temperatures, had to be independently, flexibly supported.

Grinnell recommended its *regular* Constant Support Hanger* to accommodate most of this thermal movement. Then, 3 *standard* Variable Spring Hangers* were attached to a specially constructed assembly to accommodate changes in position of each of the 3 lines being operated at different temperatures.

Grinnell's piping background of more than 100 years proves invaluable when it comes to solving unusual problems like this. It is why it will be to your advantage to bring your next pipe suspension problem to Grinnell. But to profit *most* from Grinnell's expert knowledge, the time to act is during the planning stage. Write: Grinnell Company, Inc., 277 West Exchange Street, Providence 1, Rhode Island.



GRINNELL CONSTANT SUPPORT HANGERS maintain full safety factor in high temperature, high pressure piping. Compact design — extended range of sizes for loads from 27 lbs. to 57,500 lbs., with travels up to 16 inches.

GRINNELL VARIABLE SPRING HANGERS provide minimum variation in supporting force — a variation of only 10½% of rated capacity per ½″ deflection for standard spring models. 21 sizes in standard, short and double spring models — capacities, 50 lbs. to 28,200 lbs.

*Patented

GRINNELL

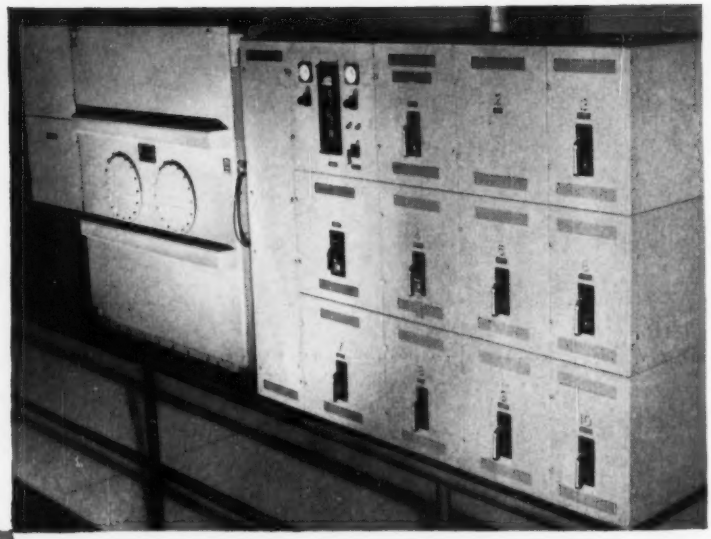
AMERICA'S #1 SUPPLIER OF PIPE HANGERS AND SUPPORTS

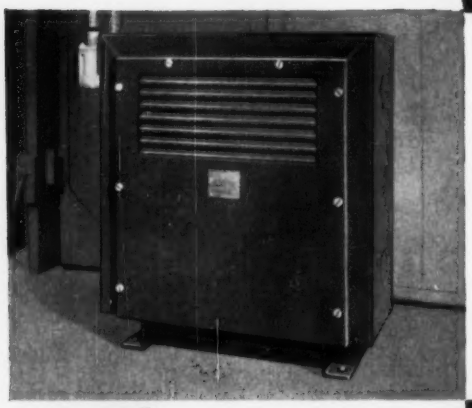
For more data on advertised products, use Readers' Service Cards, last page.

Wagner

SEALED DRY-TYPE TRANSFORMERS

These modern unit substation transformers can be safely installed in any load-center—any place—because they are hermetically sealed in welded steel cases to provide positive protection from contamination, fire and explosion hazards. The only maintenance needed is periodic checking of gas pressure (inert nitrogen), case and bushings.





Here's Reliable Power

for your plant electrical system

WAGNER LOAD-CENTER TRANSFORMERS

Wagner

INDOOR DRY-TYPE TRANSFORMERS

These new quiet-type transformers are compact, light in weight, provide a flexible, modern power system to change higher voltage distribution service to lower voltage lighting and power circuits. They meet all safety requirements for indoor installation.

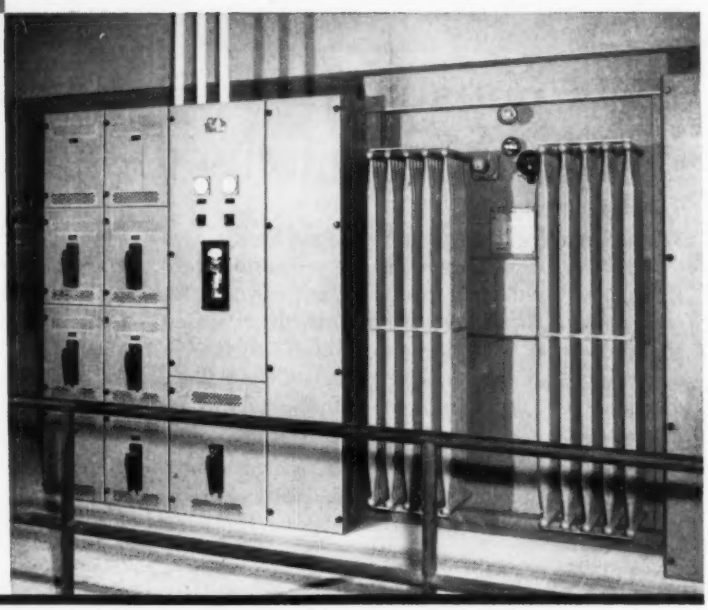
Wagner

NOFLAMOL TRANSFORMERS

Non-inflammable liquid filled. For indoor or outdoor installation. Close-coupled design fits flush against switchgear enclosures, to eliminate and save space. Throat-connected designs are also available.

Bulletins TU-205 and TU-214 give full information on Wagner Load-Center Transformers. Write today.

WT59-2



BRANCHES AND DISTRIBUTORS IN ALL PRINCIPAL CITIES

Wagner Electric Corporation

6458 Plymouth Ave., St. Louis 14, Missouri.

SERVING 2 GREAT GROWTH INDUSTRIES . . . ELECTRICAL . . . AUTOMOTIVE

FLUIDICS AT WORK

Precipitator separates 15 to 25 tons of ashes per day for U.S. Rubber Co.

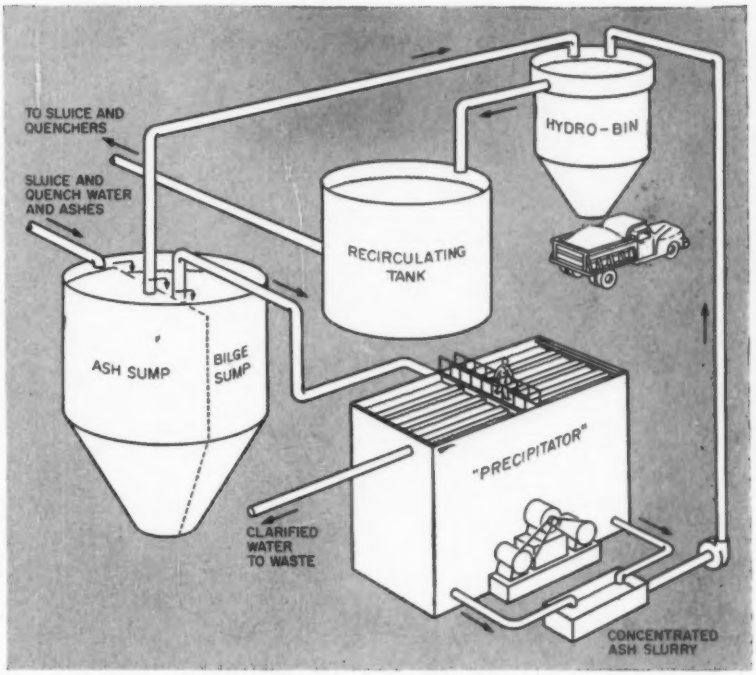
. . . makes ash-handling system flexible, dependable.

Ash problems at U. S. Rubber's Detroit plant are typical. The powerhouse has widely varying loads . . . requiring a *flexible* ash-handling system. The system must also be *dependable*, because all clarified effluent water goes into the Detroit River and this water must not contain suspended solids that could obstruct the river channel.

Tests were run at U. S. Rubber's plant using a pilot-scale Permutit *Precipitator*. As a result of these tests, a 300 gpm horizontal unit was installed. (See simplified flow chart.)

U. S. Rubber's Permutit *Precipitator* goes a long way to make their system successful. In use over 2 years, the Precipitator handles varying loads of 15 to 25 tons of suspended ash per day . . . at low cost without coagulants or other chemicals . . . yet it always delivers effluent water as clean as the river water itself.

Pfaudler Permutit offers impartial advice about water treatment . . . based on experience with all basic types of solids separation equipment – coagulation, settling, flotation, centrifuging, evaporation and ion exchange. Write to our Permutit Division, Industrial Waste Treatment Dept. PR-39, 50 West 44th St., New York 36, N.Y.



PFAUDLER PERMUTIT INC.

SPECIALISTS IN **FLUIDICS...**

THE SCIENCE OF FLUID TREATING AND PROCESSING

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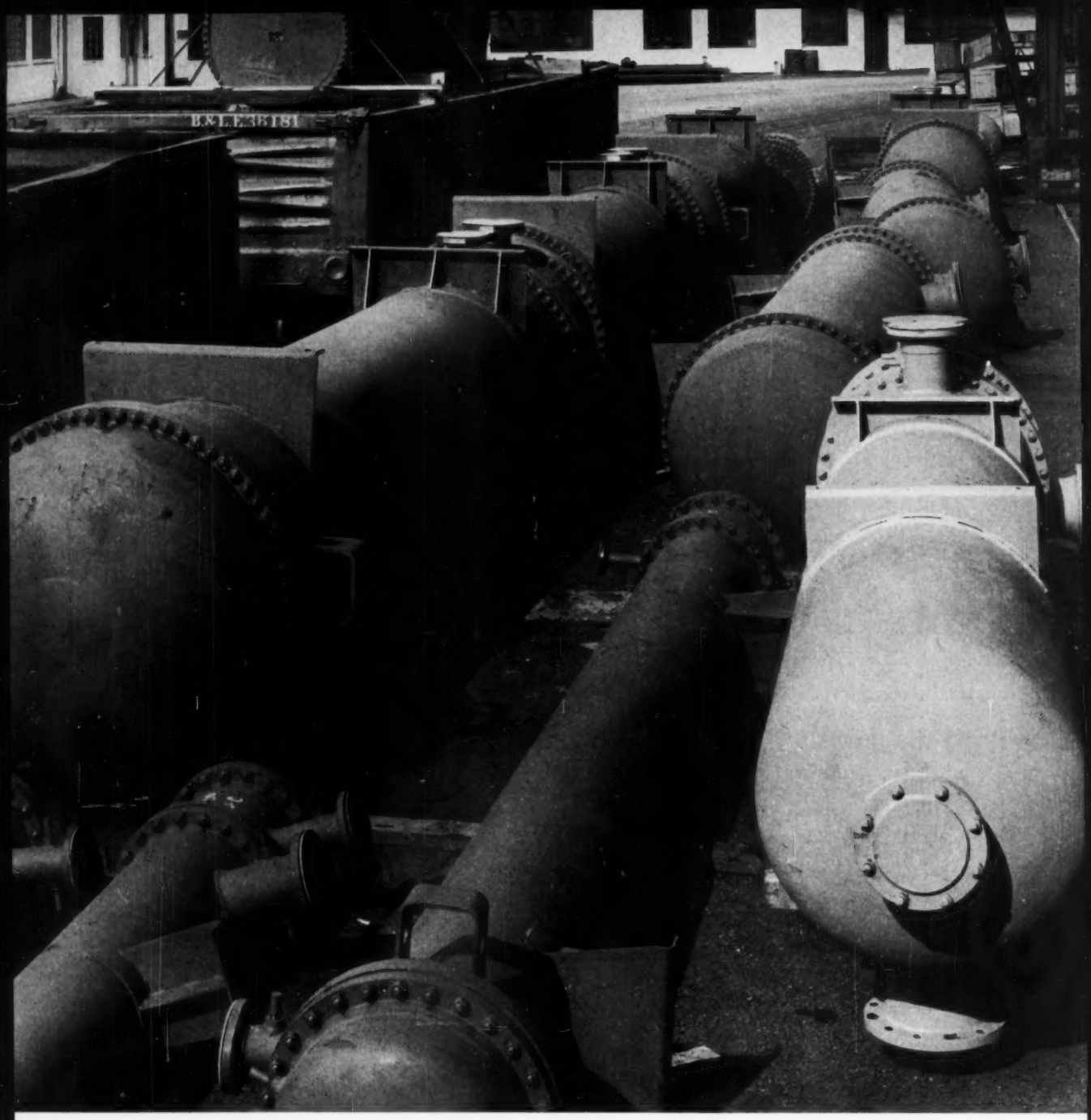
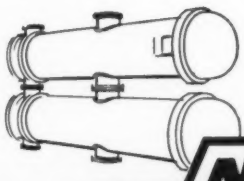


READY TO GO . . . these heat exchangers are but a small sample of the many that continuously come off the assembly line, in various shapes and sizes, for petroleum refineries and chemical plants, at M. W. Kellogg's Jersey City shops. For promptness in service plus the optimum in design, engineering, fabrication, and cost, call Kellogg's Fabricated Products Sales Division.



THE M. W. KELLOGG COMPANY, 711 THIRD AVENUE, NEW YORK 17, N. Y.

A SUBSIDIARY OF PULLMAN INCORPORATED

The Canadian Kellogg Company Limited, Toronto • Kellogg International Corp., London • Kellogg Pan American Corp., New York
Societe Kellogg, Paris • Companhia Kellogg Brasileira, Rio de Janeiro • Compania Kellogg de Venezuela, Caracas

Wanna Take a Chance ?

You can take your choice of over 200 heat transfer equipment manufacturers when you are buying heat exchangers.

Of course, they don't all know heat exchange theory intimately, but it is comparatively easy for a metalworking shop to put together a simple exchanger.

To improve your odds on getting the *right* equipment, why not let us be one of the next manufacturers you talk to. We have spent 90 years in the heat exchange business—years that have built our reputation as being one of the most engineering-wise companies in the field. We can understand what you need and we can design and construct equipment for you that is exactly right.

Specialists in the engineering and construction of heat exchange equipment

air, gas and liquid heat exchangers, coolers and heaters—finned and bare tube, evaporators, steam generators, condensers, tank heaters, air-cooled fin-fan exchangers, sea water distilling plants, helically and longitudinally finned tubing, and many other products.

Griscom-Russell | A GENERAL PRECISION COMPANY

THE GRISCOM-RUSSELL COMPANY
MASSILLON, OHIO
A SUBSIDIARY OF GENERAL PRECISION EQUIPMENT CORPORATION

GR389

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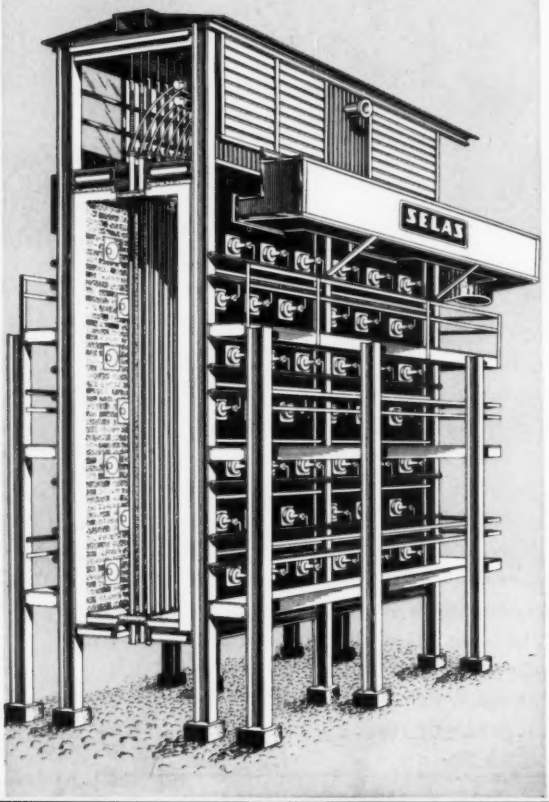
NOW

A SELAS VERTICAL TUBE FURNACE

with all these benefits of GRADIATION® HEATING:

- ***PRECISENESS***
- ***UNIFORMITY***
- ***ZONE CONTROL***
- ***VERSATILITY***



STEAM-METHANE REFORMING is accomplished in this Selas Vertical Tube Heater under accurately controllable conditions.

SELAS CORPORATION OF AMERICA DRESHER, PENNSYLVANIA

Heat and Fluid Processing Engineers

DEVELOPMENT • DESIGN • CONSTRUCTION

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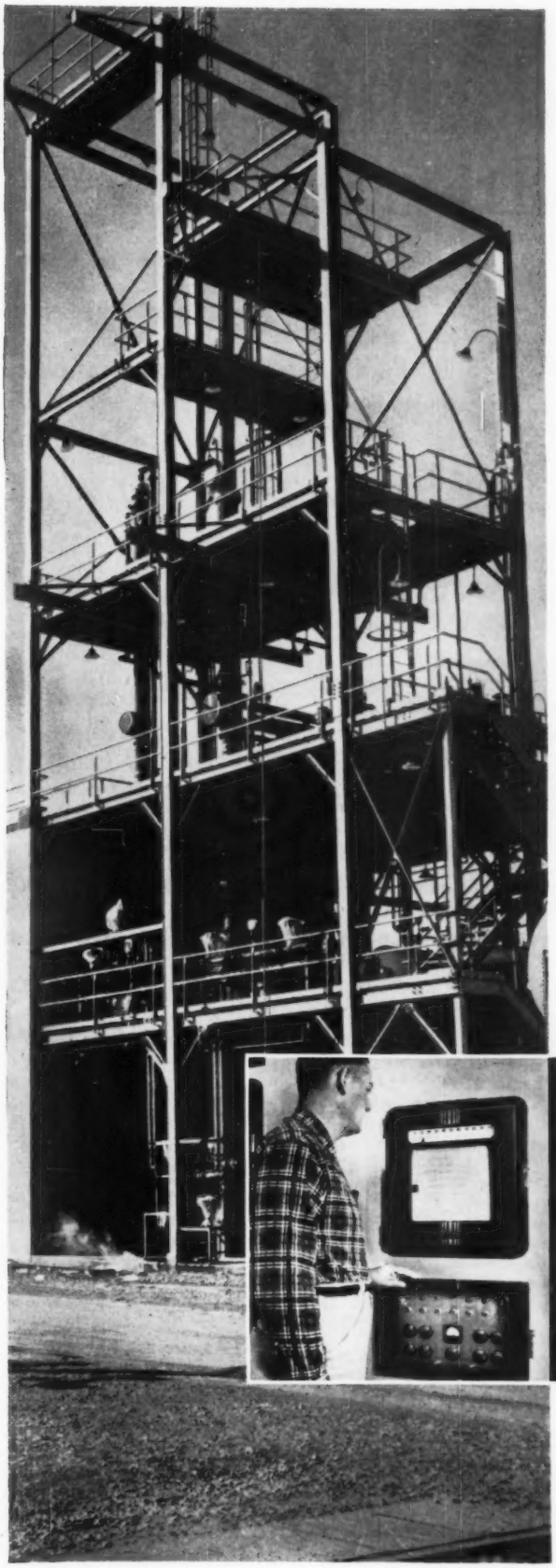

New

CHROMOMAX*

helps Pennsalt boost product quality

For more than six months, Pennsalt Chemicals Corporation at Calvert City, Ky. has based control of its Isotron plant on Chromomax data. Component concentrations as low as 0.01% are detected and measured by this highly sensitive L&N Chromomax Gas Chromatography Analyzer. It enables Pennsalt's operator to monitor impurity levels every 10 minutes . . . to make any necessary control adjustments. The result: the refrigerants and aerosol propellents produced have a purity of more than 99%.

Pennsalt also relies on Chromomax because it's dependable . . . needs only routine maintenance . . . requires simply a weekly check against a standard sample. The instrument maintenance group finds that programming cycles are easy to reset after a process changeover. These benefits confirm Pennsalt's policy of getting the best instrument for the application.

If you, too, have a process stream measuring problem, let L&N's versatile Chromomax Analyzer solve it . . . economically . . . dependably. If required, your Chromomax can be equipped with dual column switching or electronic integration.

Check with your nearest L&N Office for application details or write to Leeds & Northrup Company, 4923 Stenton Ave., Phila. 44, Pa. for information.

**Trademark*

In the control room of Pennsalt's Isotron plant, a process operator checks component variations on a Chromomax Analyzer as a guide to resetting control points.

LEEDS NORTHRUP
Instruments Automatic Controls • Furnaces

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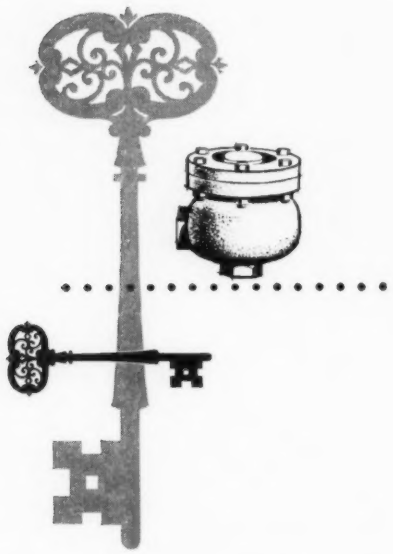
Who Holds the Key in Turnkey?



Not the consulting engineer.

Not the prime contractor.

Not the subcontractors.

Not even the customer's representative who, assigned to build a plant and stay within the building budget, is too often willing to forfeit the future for a good cost showing today.

The key to this plant's productivity and profits is held solely by the *owners*.

The owners must, of necessity, think in terms of how much this plant will produce, and at what cost. They must, of necessity, think of *total cost*.

Total cost includes the price of original equipment, the expense of installing it, and how much it costs to maintain it over the entire useful life of the plant.

Take steam traps, for example. Lots of traps cost less than Nicholson's. In a box on the jobber's shelf, that is.

But when the plant *owners* have paid the cost of installation, and "dry, clean steam" has been contaminated by everything from weld bead to broken beer bottles and the *owners* have paid the cost of that, and finally when the "bargain" traps have broken down in service—the *owners* call on Nicholson.

Quality Nicholson steam traps, sometimes higher in initial cost but always lower in installed cost, have long enjoyed the reputation of being the *owners'* favorite—the favorite of the people who, in the long run, have to pay the bill. ST-100

NICHOLSON

OF WILKES-BARRE

W. H. Nicholson and Co. • 14 Oregon Street • Wilkes-Barre, Pa.

Distributors in all principal cities

For more data on advertised products, use Readers' Service Cards, last page.

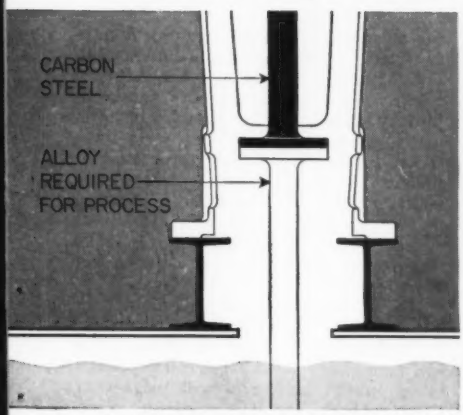
If you want to cut fluid mixing costs
look inside the tank

You can make some of your biggest cost reductions *inside* the tank, when you select a mechanical mixer for fluids.

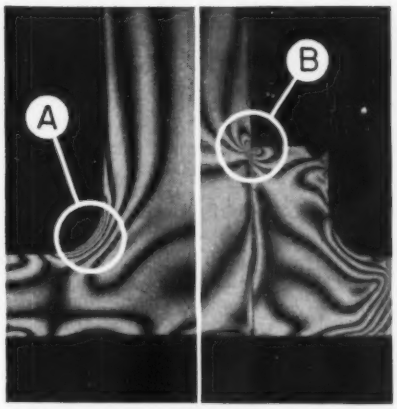
These are *long-term* savings—based on low-cost maintenance, trouble-free service, adaptability to changes in your process, minimum spare-part requirements.

These are the areas where you can *really* save money on fluid mixing. And here are some in-the-tank reasons why you can do it better with LIGHTNIN Mixers than with any other make. For lowest-cost fluid mixing, see your LIGHTNIN representative soon. He's listed in Refinery Catalog. Or write us direct.

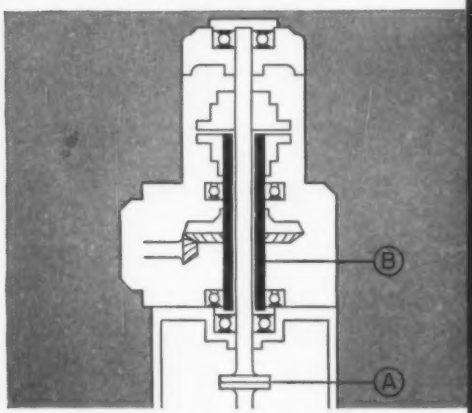
Save 6 ways with these *Lightnin* shaft and impeller refinements



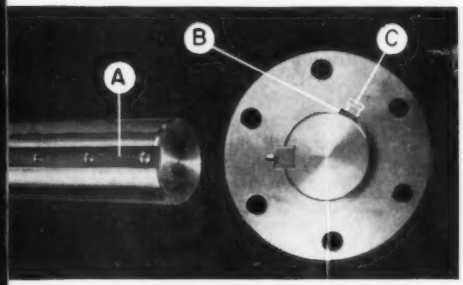
1. Get lower-cost installation, upkeep with two-piece shaft. Standard on open-tank units (available with closed-tank units, too), lower section is alloy required for process; upper section can be inexpensive carbon steel. Rigid coupling has rabbeted joint assuring accurate alignment.



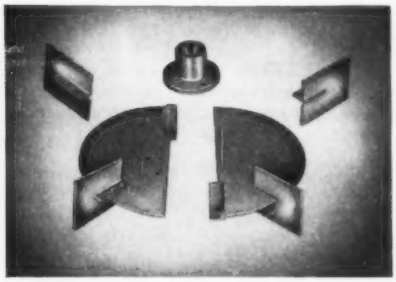
2. You get twice the strength of conventional shaft couplings with LIGHTNIN deep-welded coupling (A). Not one of these couplings has ever failed in service. Polarized light shows how machined and polished radius eliminates stress concentration found in conventional coupling (B).



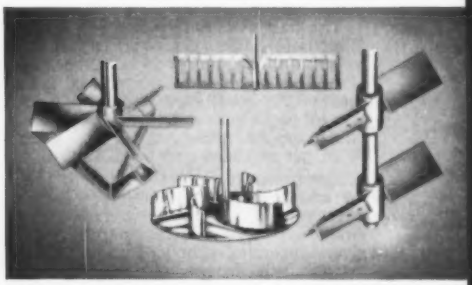
3. No need to disturb gearing if you ever want to replace a LIGHTNIN shaft. Lower shaft is unbolted at (A). Upper shaft slides out of hollow reducer quill* (B). Gears remain untouched—cannot get out of line. When new shaft is installed, shaft alignment is automatic. *Patented



4. Save time positioning impellers. Standard 18-inch shaft keyway (A) provides seven positions (more if you want)—saves you cost of special machining. Also note shallow extra keyway (B) for impeller hub setscrew (C). It permits impeller to slide freely, even if shaft is burred.



5. Cut impeller replacement cost with LIGHTNIN all-bolted design. Replace blades without buying a whole new impeller. Blades come off to pass small openings; or impeller can be supplied split, as shown. Same disc takes 4, 5, 6, or 8 blades for easy change in power input.



6. Get the right impeller for your needs. You can handle practically any fluid mixing requirement with a standard LIGHTNIN impeller. But for special jobs, you can get LIGHTNIN impellers made to specification in all machinable materials and with widest choice of coverings.

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- ☐ Top entering; propeller types: ¼ to 3 HP (B-103)
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- ☐ Confidential data sheet for figuring your mixer requirements (B-107)
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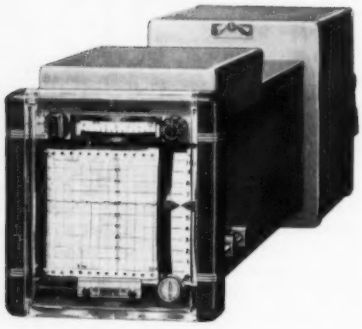

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The Mail Box...

Japan Asks Details

To the Editor:

With great interest I have read Dr. Hatch's article "Look Carefully at BTX Aromatics" in PETROLEUM REFINER, Vol. 37, November, 1958.

On Page 179, you illustrate that alkylation of toluene and propylene produces only *p*-cymene.

F. E. Condor, J.A.C.S., **71,** 3544 (1949) indicates that toluene alkylation with propylene gives three isomers in almost equal proportions, and owing to their similar physical and chemical properties, their isolation is difficult.

If *p*-cymene is obtained exclusively or isolated easily as you say in your article, this process will be very interesting for terephthalic acid production.

Will you please let me know the details about that?

T. Imai, Survey Section
Mitsubishi Chemical Industries Ltd.
Kanagawa-Ken, Japan

Author's Comment

Thank you, Mr. Imai, for your letter in which you call my attention to the fact that all the isomeric cymenes are formed in the alkylation of toluene by propylene.

I did not intend to imply that the propylene alkylation of toluene produced only *p*-cymene. All three isomers are formed as you noted. I used the para isomer to illustrate their formation and oxidation to the corresponding cresols because of space limitations. A subsequent sentence related to the use of synthetic cresols from the cymenes implies the formation of more than one cresol thus more than one cymene.

I am sorry that I did not state clearly that all three isopropyl toluenes are formed and that they are difficult to separate. Their separation is not essential for their use in the synthesis of cresols because the cresols are used as a mixture of isomers.

Lewis F. Hatch
University of Texas, Austin — Department of Chemistry

Coking Record?

One of our letters of the January "Mail Box" (Page 139) asks whether 240 days was a record run for a delayed coker. Coking is a mighty old process and it would be difficult to verify who holds the record run. However, Tidewater claims that their fluid coker has been in operation for 309 days. Fluid coking is a relatively new development.

Editor

Past Teething Era

To the Editor:

The article on hexamethylene tetramine (September, 1958 PR, Page 351) contains an error where the author mentions the Meissner hexamine process which starts direct from gaseous formaldehyde-air-mixtures. He finishes up with the remark that while high yields have been claimed that commercial utilization of the process has not come to his attention.

Since the time the new method has been developed we have built and put into operation plants with a capacity of 500 kilograms, 1, 4, and 8 metric tons per day. Thus the Meissner hexamine process has been widely tried out in practice and is free from "teething troubles."

Meanwhile several years' operation of the 4-ton plant evidenced the correctness of our forecast regarding the high yield and the other advantages of our method. We wish to mention, above all, the saving of about half of the equipment hitherto needed, the evaporation into crystalline hexamine by aid of the heat of reaction, that is without any consumption of steam, and the completely automatic control of the entire process. We contend that the Meissner process is at present the most economical hexamine manufacturing method of the world, and that in most instances the adaption of existing hexamine manufacturing plants to our system will pay well within a few years.

We recently made an agreement with Girdler Construction Division, Louisville, Ky., where as of January 1, 1959 Girdler will take charge of our general representation in the USA and will market in America both our continuous nitration method, etc., and the new hexamine process.

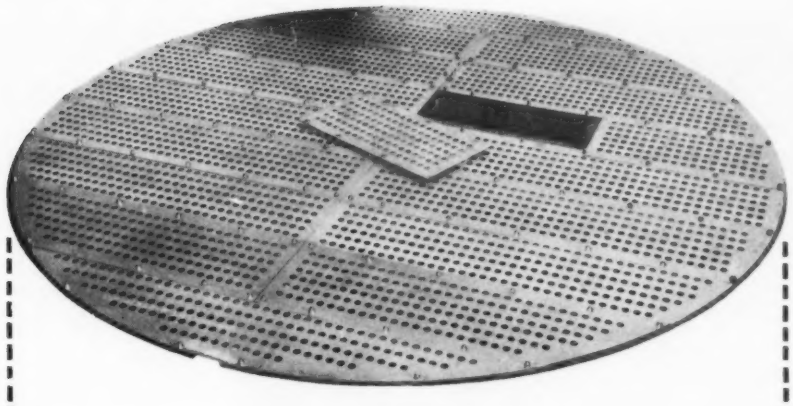
Josef Meissner
Koln-Bayenthal, Western Germany

Credits Cited

To The Editor:

We enjoyed reading the refining story in your Special Centennial Issue of January, 1959. However, we feel that you were not completely informed as to the origin of commercial catalytic cracking operations. We are enclosing a copy of of a summary entitled "The Catalytic Cracking Story" which has been prepared by Socony Mobil, and presents the history of the development of catalytic cracking from our viewpoint. We recognize that other companies had a part in the development of catalytic cracking and may view this from a different standpoint. However, a careful review of patents granted in this field should be enlightening. We would appreciate very much your correcting the impression given by your article on Page 162 that Socony had no part in the original development of catalytic cracking.

We believe we should also call to your attention one other item on Page 188 in your "Refining Hall of Fame." You said that Dr. Kalichevsky "developed Thermofor Catalytic Cracking." We do not want to detract from any kudos anybody extends to Kali, but feel it is only fair to point out that at the time Thermofor Catalytic Cracking was developed, Dr. Kalichevsky was occupying most of his time in lube oil and gasoline treating



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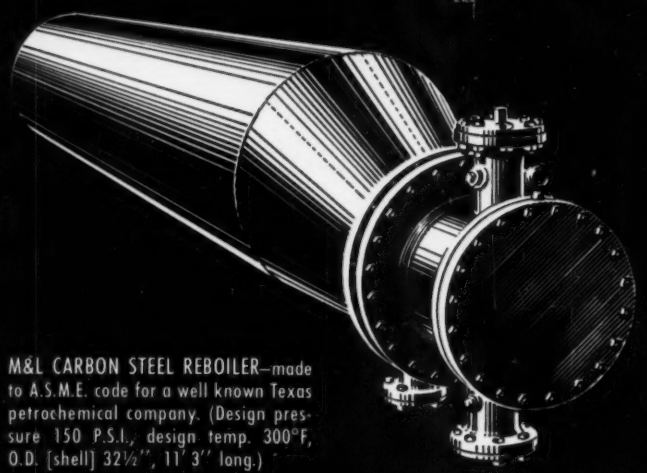

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The Mail Box...

work, and contributed very little to catalytic cracking.

James P. Shambaugh, Manager
Process Promotion Division
Socony Mobil Oil Co., Inc.
New York

Editor's Note: *By emphasizing the importance of regeneration to the catalytic cracking process, the attention was inadvertently shifted away from Socony (then Vacuum Oil Company). However, we certainly wish to recognize their role in the development of catalytic cracking. We also appreciate the information on Mr. Kalichevsky. Our association of him with the Thermofor Catalytic Cracking process was based on an award citation for 1955 made by the American Chemical Society.*

Another Worthy

To the Editor:

I would like to congratulate you on the fine Centennial Special Report in your January issue. Interested in the history of science and technology as a hobby, I really appreciate this issue.

The choice of representatives in the "Refining Hall of Fame" was very interesting, although I would liked to have seen Silliman there too. However, he is remembered on Page 148.

Peter W. van der Pas
South Pasadena, Calif.

Editor's Note: *It was difficult to leave off our "Hall of Fame" list (January 1959 PR p 188) the names of quite a number of industry worthies. Benjamin Silliman was professor of general and applied chemistry at Yale University and back in the middle 1850s completed an analytical report that, dealing with the possibilities of the use of oil, was termed "a chemical classic that touched off an industry."*

Errata

Heat Transfer Nomographs—Part 3, Dec. 1958 page 122. In the example using Figure 8 for Reynolds numbers for gases, the viscosity of air should be 0.01794 (not 0.102) and thus the resulting Reynolds number should be 600,000 (not 1,000,000.)

Heat Transfer Nomographs—Part 4, Jan. 1959 pages 223 and 224. The caption on Figure 9 should read "Prandtl number for liquids." The caption on Figure 10 should read "Prandtl number for gases."

The title of the article by A. Bondi on Page 161 of the February, 1959, issue of PETROLEUM REFINER should have read "For Condensed Cyclic Aromatics . . . Predict Hydrogenation Equilibria." Also, change first line in Table 8 on Page 163 to read:

$$(\Delta Hh^{\circ})_o = \Delta Hh^{\circ} + n \times 2{,}032 - m \times 745 \quad \text{(cal/mole)}$$

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No longer is it necessary to pay a premium to obtain the heavier flanged end valves, pumps and other piping components required to withstand bolting to raised face steel flanges in a welded piping system.

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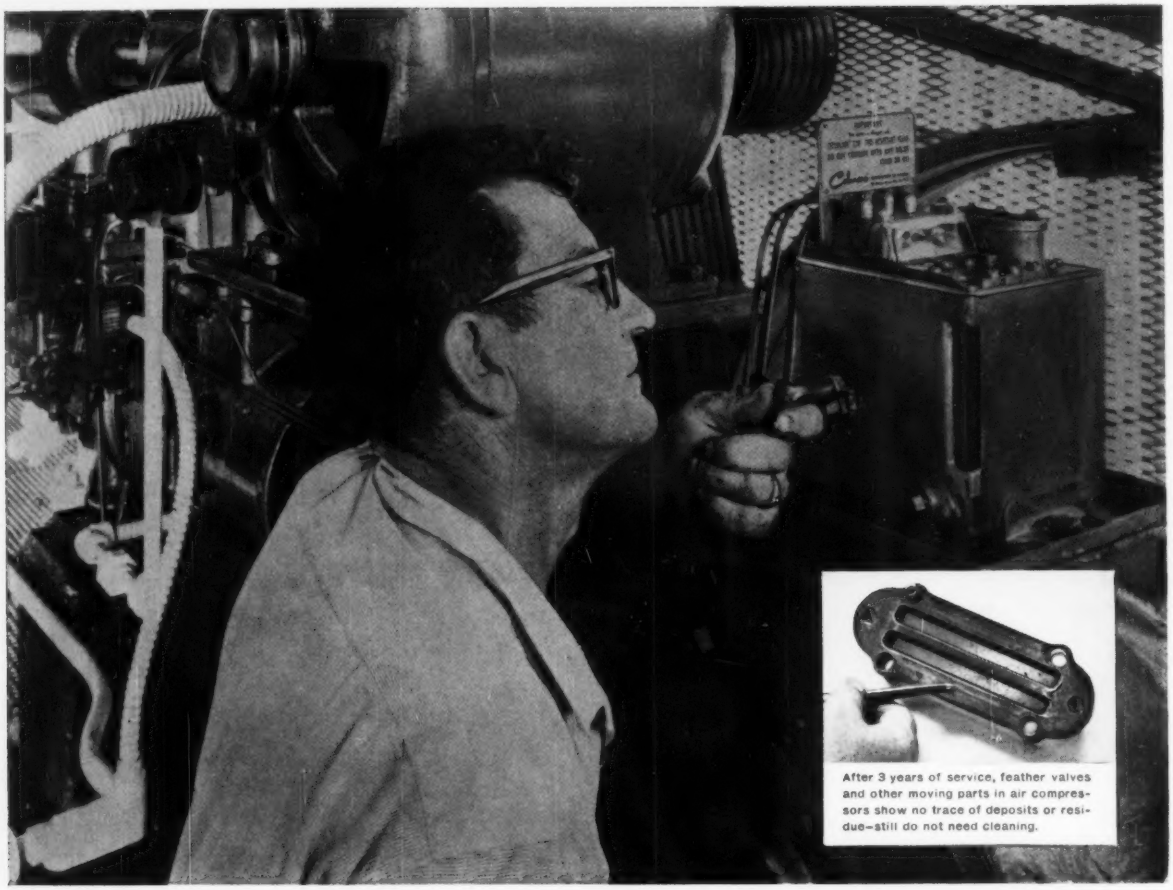

After 3 years of service, feather valves and other moving parts in air compressors show no trace of deposits or residue—still do not need cleaning.

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"First and most important, of course, is the elimination of any risk to our personnel—from fire, explosion, or fragmentation. Secondly, we save on heavy equipment replacement costs, and thirdly, down-time losses.

"A major savings is in preventive maintenance. Formerly, we completely disassembled and cleaned air compressors every six months. Cellulubes keep machinery so clean that this interval has been indefinitely extended, and so far we've saved at least 60 man-hours. Finally, Cellulubes never get 'dirty,' nor do they burn away by friction or compression."

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THEY HELPED PLAN THIS ISSUE. The 1959 Maintenance Report editorial conference was held to establish the limits and type of editorial content for this issue. Attending the conference were the industry guests shown above, left to right: Pete Nairn, Phillips Chemical Co.; Jim Kendall, Petro-Tex Chemical Corp.; R. M. Oaks, Shell Chemical Co.; H. E. Fischer, Crown Central Petroleum Corp., and Sam Naifeh, Phillips Chemical Co.*

1959 Maintenance Report

FOR THE ENTIRE petroleum processing industry, it would seem logical that maintenance procedures should be fairly uniform. But the more you read, the more you become convinced that the opposite is true! For instance, have you ever listened to a maintenance panel discussion? Regardless of the topic, maintenance superintendents pop up everywhere and get their two cents worth in for a pet idea. The article in this issue, *Maintenance Ideas Vary Among Companies,* will show you exactly what I mean. There seems to be general agreement as to the advantages of planning and scheduling, preventive maintenance, equipment cost control, housekeeping, work backlog, etc.; but the specific methods of procedure are varied and colored with philosophies of the plant and individual superintendents.

Who is right? Or, who has developed the best procedure for a particular program? I think that the answer is that there is probably *no* absolute best procedure *for all plants.* If the operations, site conditions and personnel were substantially the same, there *would* likely be *one* best procedure. Since this is not true, this collection of articles and those to be published in the months to come will give you a sampling of techniques and procedures used in a great variety of plants.

Even the authors will tell you that these techniques should possibly be modified for your plant. But by reading about the latest maintenance thinking in *this* industry, you will be able to see whether your plant is well down the road to maintenance cost reduction or whether it is staggering under maintenance procedures that worked fine yesterday but keep costs high today.

Frank L. Evans
MAINTENANCE AND DESIGN EDITOR

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***The attendance by executives, engineers, superintendents and other employes of oil and petrochemical companies at these conferences does not constitute an endorsement of Petroleum Refiner over any other publication. The fact that men of outstanding ability are allowed to attend these planning conferences shows the interest which the oil and petrochemical industry has in sound editorial content planned for the benefit of the industry and those who work in it.**

Petroleum Refiner's 1959

The graph figures indicate maintenance costs as a percent of replacement cost

MAINTENANCE COSTS are one of the most elusive items on the face of the earth. Engineers and plant managers will give you a shoot-from-the-hip answer all day long on what it costs to maintain their plants. But accurate published figures are another thing.

With this absence of maintenance cost information in mind, PETROLEUM REFINER decided to survey *all* of the refineries and petrochemical plants in the United States. The idea was to establish a maintenance cost yardstick. We know that it's practically worthless to compare maintenance costs between entire plants because the costs between large and small plants vary considerably.

But how about typical units? Shouldn't the maintenance cost of a crude unit in a large refinery be about the same as a medium sized plant? Granted that some plants, some years for tax purposes, really charge capital work as a maintenance expense and the cost information for that year will be wrong. But, the curve drawn for the unit will take a noticeable jump and can be smoothed out for a "normal" year.

TABLE 1—Composite replacement factors

Year Unit Was Completed	Replacement Factor			
	1955	1956	1957	1958
1930	2.724	2.731	2.874	2.915
1932	3.268	3.458	3.510	3.755
1935	2.953	3.132	3.260	3.388
1938	2.556	2.730	2.660	3.054
1940	2.502	2.625	2.632	2.923
1942	2.249	2.384	2.438	2.596
1944	2.114	2.246	2.316	2.438
1946	1.842	1.954	2.040	2.097
1947	1.573	1.670	1.740	1.786
1948	1.390	1.474	1.534	1.575
1949	1.318	1.400	1.454	1.456
1950	1.250	1.327	1.366	1.389
1951	1.148	1.200	1.260	1.300
1952	1.115	1.165	1.224	1.262
1953	1.074	1.122	1.178	1.215
1954	1.033	1.081	1.136	1.172
1955	1.000	1.045	1.097	1.133
1956	....	1.000	1.050	1.084
1957	....	....	1.000	1.033
1958	....	....	....	1.000

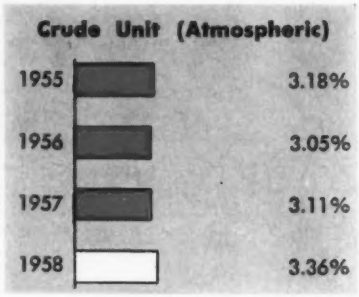
Basis for Survey. In order that all plants participating in the survey report on the same basis, a definition of maintenance cost had to be clearly established. We chose the title "Direct Maintenance Labor and Material Costs." These costs for the year in question include only direct, productive maintenance costs exclusive of burden or overhead. It excludes planning and scheduling, which is overhead, supervisory engineers, corrosion inspection, shops operation and overhead, maintenance foremen, clerical labor in the maintenance department, operating labor, power, lubricants, chemicals, and depreciation.

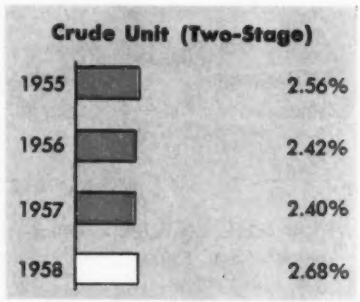
Replacement Factor. The second and probably most important aspect of finding a maintenance yardstick is to establish the replacement cost of a unit.

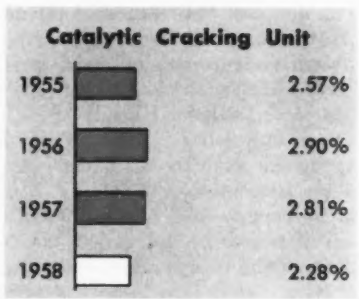
It is obvious that if you want to compare the maintenance costs of all crude units in the year 1958, for example, you will need to know the reasonable 1958 replacement cost of all crude units. A number of recognized indexes have been established that can help to update the original cost of the unit to find a replacement cost for the year in question. These authorities differ slightly on the factor to be applied to the original construction cost to find the replacement cost. So, a composite curve was drawn of the Nelson Index, Engineering News Record Cost Index, The Marshall and Stevens Index and the Department of Commerce Cost Index. Replacement factors are shown on Table 1.

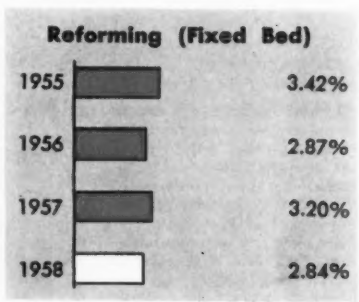
What the Graphs Show. The percentage figures shown on the graphs represent the average maintenance costs for a certain year expressed as a percent of the replacement cost.

From the above explanation, the direct labor and material maintenance cost was defined and the replacement cost has been established. By dividing the maintenance cost by the replacement cost for a certain

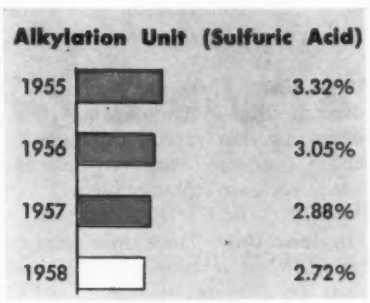


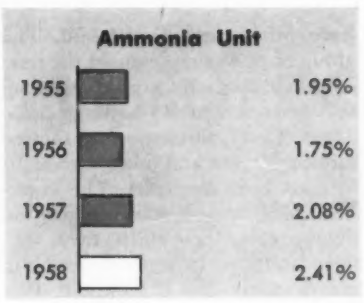


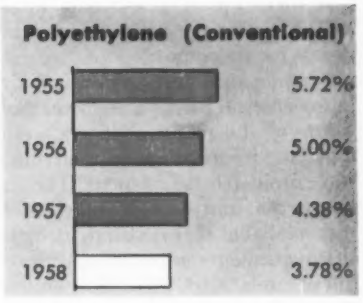


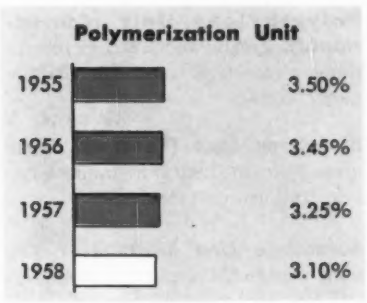


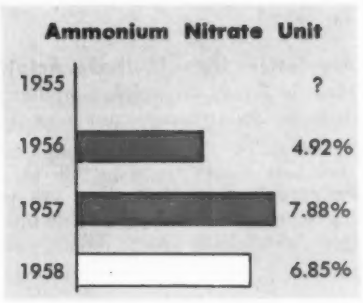
Maintenance Cost Survey

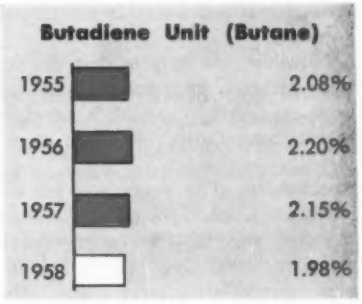


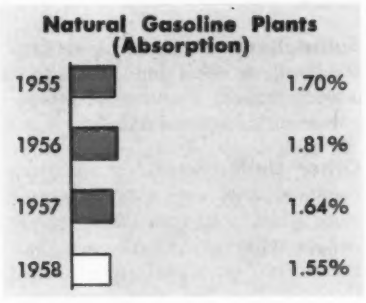


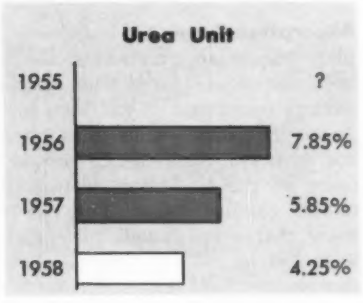


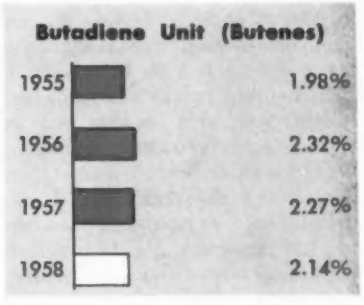


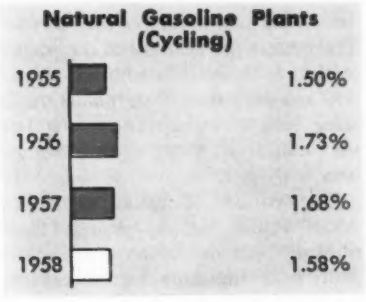


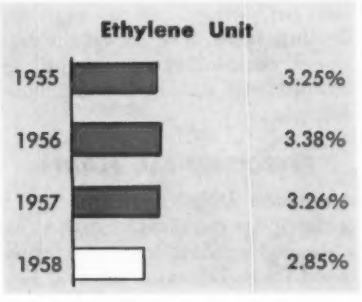


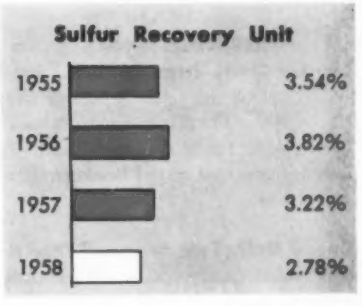












year, a percentage figure can be found.

Example. An absorption type gasoline plant was built in 1953 for 4½ million. The 1956 maintenance cost was $90,000. To find the 1956 replacement cost, multiply 4.5×10^6 times 1.122 (Table 1) for a value of $5,049,000. The maintenance cost in 1956 as a percent of replacement cost is 9×10^4 divided by $5.049 \times 10^6 = 1.78$ percent.

EVALUATION OF SURVEY

Each of the units surveyed will be discussed with an evaluation of

the results. Keep this important statement in mind when looking over the graphs. The returns on refining units and the natural gasoline plants was reasonably large and we feel that there was sufficient data to establish definite maintenance cost trends for these units.

Maintenance cost percentages for petrochemical plants is another story. Many of the plant managers wrote that cost information on their units was considered confidential. The result is that not enough information was available to establish definite cost percentages as was true with refinery units and natural gasoline plants. The exception is ammonia units, for which a sizable return was received.

However, we believe that the returns on each petrochemical unit were enough to establish a trend in maintenance costs on these units.

Procedure. The procedure for establishing a trend for all of the units reported was to draw a separate curve for every unit reported. With many curves on a large graph, it is readily apparent which points are unreasonably high. It was not uncommon to find one point on a curve extremely high in relation to the remaining points. Unusually high maintenance costs for that year because of turnarounds, emergency breakdowns, or possibly a capital expansion for the unit charged as a maintenance expense caused this sudden departure. By taking these departures into account, an industry-wide trend was easily drawn for each unit.

REFINING UNITS

Crude, Unit, Atmospheric. Practically all of the units reported were fairly old. Therefore, maintenance costs were relatively high with an increasing trend noted between 1957 and 1958.

Crude Unit, Two Stage. The average maintenance cost for these units seemed to be slightly lower than those for an atmospheric unit but are also on the increase. Being a larger unit than the atmospheric type and the probable use of maintenance-free equipment may explain the lower maintenance cost.

Catalytic Cracking Unit. These units show a definite downward trend. The curves indicate a maximum maintenance cost sometime in 1956 and a steady decrease since.

Reforming Unit, Fixed Bed. This group of curves represented the most erratic plotted. By erratic is meant that no smooth trend could be established. Every unit reporting showed sudden upward and downward shifts in costs over the years. The corrosion difficulties in these units possibly explains these shifts. Even with these shifts, a downward trend in maintenance costs is indicated. Perhaps the major corrosion problems are licked.

Alkylation Unit (Sulfuric Acid). Here is a unit on which a uniform drop in maintenance costs was reported.

Polymerization Unit. The curves for these units also show a fairly uniform downward maintenance cost rate.

NATURAL GASOLINE PLANTS

Absorption Type. Natural gasoline plant maintenance costs have always been low as compared with typical refinery operations. It has been suggested that these plants must operate at a low maintenance cost because of the low profit picture in naural gasoline today. The curves show that even though their costs were low in 1955, a continuing reduction in maintenance costs occurred in 1957 and 1958.

Cycling Type. The curves show an almost constant agreement and indicate a very stabilized maintenance cost picture.

PETROCHEMICAL PLANTS

Ammonia Unit. Perhaps age is creeping up on these units because a decided upward trend was established for maintenance costs of these units.

Ammonium Nitrate Unit. Remember the caution previously made concerning sketchy information on the maintenance costs in this and the following petrochemical units. However, from those reporting, it seems that maintenance costs were all unusually high in 1957, indicating possible uniform capital expansion charged as a maintenance expense or a market condition that made maintenance for that year very high.

Urea Unit. These units reported a decided drop in maintenance costs, indicating that capital expansion is about complete. However, maintenance costs are still very high.

Ethylene Unit. These units seem to be stabilized maintenance-wise and costs are dropping steadily.

Polyethylene Unit (Conventional). Erratic and sketchey returns show a downhill trend in maintenance costs.

Butadiene Unit (Butane). These units were surprising in their rather low, uniform cost figures.

Butadiene Unit (Butenes). The same comments apply to butene butadiene and to the butane type plants.

Sulfur Recovery Unit. Aside from the hump in 1956, there seems to be a very definite lowering of maintenance costs for these units.

Other Units. Several other petrochemical units were surveyed—acetylene units, methanol units, formaldehyde and acetaldehyde units, pentaerythritol units and styrene units. However, we feel that there were insufficient data reported to establish valid maintenance cost trends. The editors are grateful to the plants operating these units who did report and are sorry that other plants operating similar equipment felt that they could not share their information with you.

The editors of PETROLEUM REFINER would like to express their sincere gratitude to the plant managers and engineers compiling this information for their cooperation with this survey. It is through the cooperation of all in the processing industry that the strong and weak points in your operations can be determined and maintenance costs reduced.

# #

Six Steps to Equipment Cost Control

By controlling equipment costs, an accurate forecast of your maintenance budget can be made based on factual data

W. S. Luck
E. I. du Pont de Nemours, and Company, Wilmington, Del.

IN THE PETROLEUM and chemical industry, today's plants are made up of processes which are based on complex, costly equipment requiring continuity of operations. These modern plants provide tremendous potential for a reduction in operating cost. However, because of the necessity for reducing outage time to a minimum, maintenance cost is becoming a larger part of operating cost. Therefore, it is imperative to control the maintenance expenditures, since, on many plants, maintenance can become a big business.

Maintenance Cost is defined as the expenditure of labor and material in the inspection, lubrication, adjustment, repair, overhaul, or replacement of equipment, buildings, and facilities. The time has passed when the plant engineer could, or believed he could, control maintenance expenditures by controlling total labor and material dollars or maintenance cost by departments. Total cost now means little to him unless he is able to analyze this cost by specific pieces of equipment.

The problem associated with equipment cost is one of handling, recording and retrieving desired information from a mass of data. A manually operated system can become cumbersome and costly, requiring a large clerical force to gain the desired information. This leads us to the question, **"How can we control equipment cost in an effective, economical manner?"**

An equipment cost control system can be compared to a gold mine. To

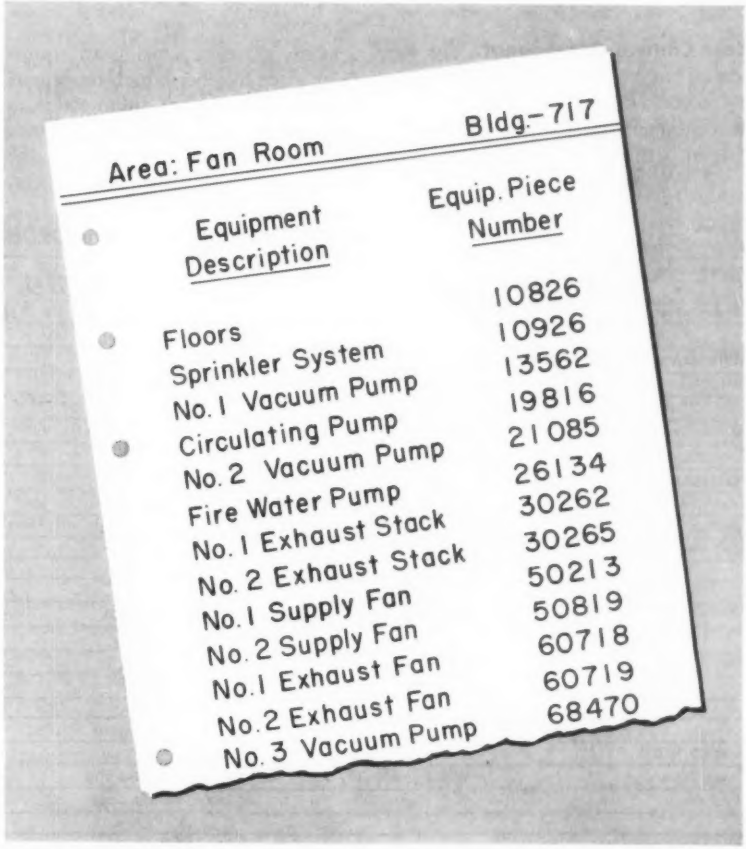


FIGURE 1—Pocket notebook leaf describes area equipment and gives its piece number.

hit "pay dirt," it is necessary to dig in a mine. Likewise, the information developed through the system must be continually analyzed and corrective action initiated to obtain maximum results.

It should also be recognized that an effective equipment cost control system costs money. Management must be convinced of the need of the system and provide the necessary qualified personnel to establish a sound engineering approach of analysis and corrective action. Only in these ways can the system be made to produce a return on investment.

A survey has shown that a majority of plant engineers have recognized the need for an effective equipment cost control system. It has also shown that in most instances the component parts necessary for establishing such a system exist on the plants. The engineering technology of how to put the component parts into an organized system is usually the missing link in the chain.

Cost Control Component. The essential component parts of an equipment cost control system are:

- A numbering system for the equipment—this can be equipment piece numbers.
- An adequate work-order system.
- A cost system that lends itself to the rapid accumulation of cost by equipment, and the issuing of reports containing these data.
- A filing system for completed, costed work orders, inspection and overhaul reports by equipment.
- The necessary engineering organization to make analyses, recommendations, and execute whatever corrective actions are deemed necessary.

Piece Numbers. In du Pont, some of our plants are in the process of solving the problem of equipment cost control through the application of "equipment piece" accounting, "management by exception", the use of tabulating equipment to accumulate information and issue reports, and a strong preventive maintenance program. These, combined with a sound budgetary control based on equipment cost, have resulted in major cost reductions.

Many plants are using an equipment piece number which represents a definite investment dollar value to accumulate costs. The maintenance cost per year, as a percent of the investment value of the equipment, can then be used for control purposes.

The installation and operation of an equipment cost system has been accomplished on a du Pont plant in the following manner:

Step One. The first step is to set up "Lefax" pocket notebooks for all maintenance supervision and the work-order clerk. The notebook contains the area in which the equipment is located, a description of the equipment, and the equipment piece number pertaining to the equipment. Figure 1 is a leaf from such a notebook.

Step Two. The second step is to review the work order procedure, including the work order form. The work order form, an example is shown on Figure 2, is used as a means of communication in requesting maintenance work. It must contain information on the work to be done, an estimate of the job cost as to labor and material, authorizations, and other pertinent information relative to keeping equipment costs. After being written, the order is processed through the maintenance foreman of the area who checks for clarity of information, enters the equipment piece number in the space provided on the form.

TF-24

WORKS ENGINEERING JOB ORDER

Area Code 9717	Job Type	Job Ord. No. 1234				
Job Title FIRE WATER PUMP			Date Written 8/3/58		Date Req'd. 8/10/58	
Preventive	☐ E.P. NO. 26134	Unit No.		Eq. Type PUMP	Approval Code	
	Job Cost	Labor		Material	Total	
Estimator's Initials	M.P.B	Hours	Dollars	Dollars	Dollars	
Group	12	8	20.00	12.00	32.00	
Group						
Group						
Group						
Est. Total		8	20.00	12.00	32.00	
Act. Total		14	33.20	15.00	48.20	

Author | W.E. Foreman | Assigned to | Grp.

Job Description

REPLACE SHAFT IN FIRE WATER PUMP

				Des. Chg. App.
Design Req'd.				Planning Req'd. ✓
Area Supv.	W.E. Supv.	Works Eng.	Dept. Supt.	
W.E. Supv.	W.E. Supv.	Acct. Supt.	Plt. Mgr.	

FIGURE 2—Work order form is means of communicating the requested maintenance work.

and forwards the order to the work order clerk for assignment of a work order number. The clerk also checks the equipment piece number and, if omitted, enters the proper number in the space provided on the work order form. The work order is then processed through the job planners for planning, and the scheduling system to the field foreman for job execution. At the same time a copy of the work order is sent by the work order clerk to the field foreman, a copy is sent to the tabulating section so that a tabulating card can be keypunched with the appropriate equipment piece number.

As a particular craft or skill works on the job, the foreman prepares daily a time distribution form showing the labor and material used on the job. At the end of each day's work, the time distribution sheet is forwarded to the Tabulating section.

PERIOD ENDING SEPTEMBER, 1958

Area Code Number	Equipment Piece Number	Current Expense $	Total Expense To-Date $	Investment Value $	Extended Maint. $ Cost/Yr.	Standard Maint. $ Cost/Yr.	Ratio Actual $ to Standard $
9717.....	10826	52	486	18000	656	360	1.8
9717.....	10926	7	14	6500	19	98	.2
9717.....	13562	.....	58	800	78	48	1.6
9717.....	19816	22	86	600	115	36	3.2
9717.....	21085	....	18	800	24	48	.5
9717.....	26134	48	102	600	136	36	3.8
9717.....	30262	.....	142	40000	190	600	.3
9717.....	30265	1500	1832	38000	2440	570	4.3
9717.....	50213	5	98	10000	131	300	.4
9717.....	50819	85	382	8000	510	240	2.1
9717.....	60718	....	72	8500	96	255	.4
9717.....	60719	956	1222	8500	1630	255	6.4
9717.....	68470	....	19	800	25	48	.5

FIGURE 3—Cost report gives cost of operating all equipment by piece numbers.

Step Three. The third step in the equipment cost system takes place in the Tabulating section. As information is reported daily by foremen through the daily distribution form and store tickets covering materials, the tabulating card which had been previously established is keypunched with this pertinent information. Data are continually accumulated against this card as work is performed on the piece of equipment. The equipment piece card becomes a permanent record in Tabulating, and any other work done on this piece of equipment in the future can be accumulated against the piece of equipment. When the work order is completed in the field, the Tabulating section is notified of this completion by the work order clerk. The Tabulating section then costs out their copy of the work order and returns it to the work order clerk for filing in a file set up by equipment piece numbers in the work order clerk's office.

Step Four. The fourth step in the procedure is also a function of the Tabulating section. This step covers the issuance of the equipment cost report containing expenditures against all equipment piece numbers. The frequency of the report is established by the plant engineer, and it may be issued on a monthly or a quarterly basis to interested parties. A segment of the report is shown in Figure 3. As can be seen, the report contains such information as: area, equipment piece number, expenditures for the current period, expenditures to date in the year, investment value of the equipment, extended maintenance cost per year, the standard maintenance cost per year, and the ratio of the actual cost to the standard cost per year for the piece of equipment. The ratio of the indicated yearly maintenance cost to the standard serves as the control feature of the system.

Step Five. The fifth step is a function of the equipment cost control engineer, or a corrective maintenance engineer, within the plant engineering organization. A copy of the Tabulating section's report on equipment cost is sent to the engineer. Using the report, the engineer makes his analysis by observing the last column on the right-hand side of the report. Using the "management by exception" technique, he checks only those instances where the ratio is greater than one. Those cases where the ratio is in line, are accepted. This may result in a small list of exceptions or a list containing many pieces of equipment that should be further analyzed for improvement.

Step Six. The sixth step in the procedure is the most important. This covers the equipment cost control or corrective maintenance engineer's analysis and recommendations. For his analysis, the engineer uses the list of equipment, from his exception list, and refers to the equipment piece work order file in the work order clerk's office. This file includes all inspection and overhaul reports and costed-out work orders on each piece of equipment over a three to five-year period of time. Based upon this analysis, a report is issued to the plant engineer and other interested parties on the findings with recommendations as to corrective action for controlling the cost of those pieces of equipment.

Statistical analysis provides a useful technique to determine the pattern of equipment failures and establish priority for corrective action. By plotting the number of failures against time on probability paper, information can be developed for ready analysis. The failure patterns can take different forms, depending on the types and degree of controls, such as preventive and corrective maintenance, planning, scheduling, training of skilled personnel, and equipment cost.

Figure 4, shows the failure pattern for a hypothetical piece of equipment. An analysis of this graph indicates that failures fall into three distinct areas which are classified as "infant mortality," "random failures," and "wear-out." Infant mor-

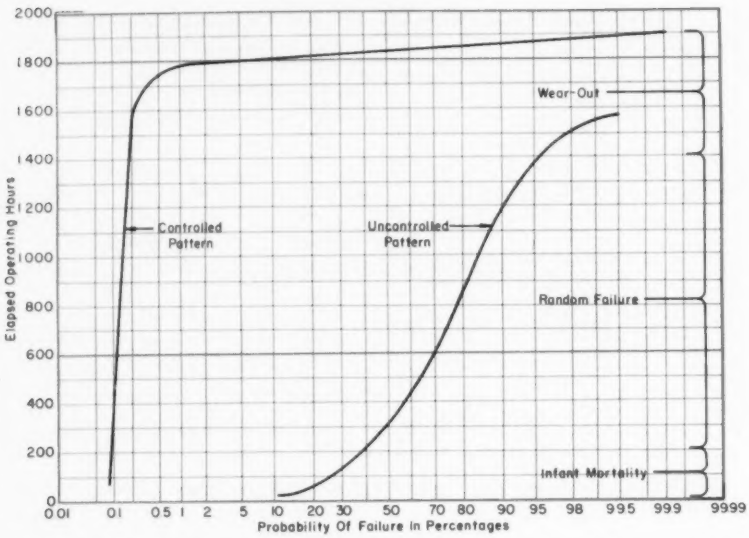


FIGURE 4—Equipment failures fall into three distinct areas: "infant mortality," "random failures" and "wear out."

tality is due to a misapplication of materials, poor installation procedures, or faulty workmanship. Random failures indicate something is out of control. This may be the process or the mechanics. Wear-out indicates that the equipment has run for its useful life. From the analysis of the graphs, the specific problems can be determined and the necessary corrective programs established.

After the infant mortality and random failures have been corrected, then the equipment should run for its useful life with a very low probability of premature failure, as shown on Figure 4 by the controlled pattern. However, corrective action should continue to determine steps necessary to insure longer useful life of the equipment and thus obtain longer operating hours between failures.

It is the function of the equipment cost engineer to make these analyses from the Tabulating section's equipment cost report and the equipment piece file. It is his responsibility to develop programs to control the cost and the pattern of equipment failures through recommended corrective action and follow-up.

The equipment cost control system can be summed up into six steps:

1. Set up an equipment piece numbering system and develop a number notebook.
2. Design the work order system for the transmittal of information required.
3. Arrange for the Tabulating Section to establish equipment piece cards for accumulating information and set up an equipment piece information file in the work order center.
4. Arrange for Tabulating to issue equipment cost reports periodically.
5. Assign the necessary engineering assistance for analyzing the report and establishing the exception list.
6. Establish the necessary engineering assistance for the analysis of the equipment file and the issuance of reports containing recommendations for corrective action.

Budgets. Once the equipment cost system is established, the information developed from the Tabulating section's reports can be used very effectively in establishing budgets for over-all cost control. Since the report shows the ratios of the actual cost to the standard cost, this indicates the accumulation performance on the equipment over a year's period of time. Standards are established as a guide. In those instances, where the ratio of actual to standard has been less than one, the standards should be reviewed and adjusted. Standards are established in many ways. In many cases they are based upon past experience and judgment. The most accurate way is through job study by experienced standards engineers. Standards can only be as good as the facts upon which they are established. They should be continually analyzed and adjusted in order to portray an accurate degree of measurement of performance.

Good standards can be converted to dollars per year per piece of equipment for budget setting. Knowing the number of pieces of equipment and the standard dollar allowances per year per piece of equipment, then through the simple use of multiplication and addition the total budget by equipment, or by areas or by total plant can be developed.

Using this technique of controlling equipment cost, it is possible to control cost and forecast maintenance budgets on factual data. ##

About the Author

William S. Luck is a maintenance consultant for E. I. du Pont de Nemours & Co., Inc. Wilmington, Del. He advises the company on plant maintenance and engineering administrative activities. Luck has previous experience as a maintenance mechanic, methods and standards engineer, planning and scheduling supervisor, and maintenance consultant. He received B.S. and C.E. degrees in civil engineering from Virginia Military Institute in 1934 and 1940 respectively, and has presented papers before a number of professional societies.

How you can handle . . .

Day-to-Day Labor Problems

The steward and the foreman are the front line combatants on everyday labor problems. Train these two right and save yourself some labor headaches

F. L. Bradley
Stone and Webster Engineering Corporation, Boston

THERE IS no easy or royal road to trouble-free labor relations. Human beings, unpredictable as they are, should never be taken for granted. Your first line supervisor can help to smooth out the bumps on that road. He is well worth your best efforts in his development—labor relations-wise. It may take the legal type mind to draw up the union contract, but the salesman type is the more successful in its shop administration.

There is one point that seems basic. We, supervisors, must recognize that management is the development of people, and not the direction of things. Yet we are responsible for both. The outcome of every order or instruction is contingent upon the ability of people to put it into effect. Whether or not we have a union, this problem is always with us, and the presence of a union complicates it. It is necessary that all management representatives who are responsible for labor relations (and aren't we all?) remember that maintenance of management rights is fundamental. When the rights of management are being encroached upon by unions, management must protect these rights and make no concession that will result in further penetration. The encroachments on management prerogatives are made indirectly rather than directly. Therefore, they require an even more watchful attitude on the part of management people. The concessions made little by little add up to important gains in management territory by a union. It is particularly important in maintenance activities to prevent attrition of supervision's abilities to perform vital services through the efficient use of manpower and equipment. How can we accomplish this and maintain labor peace in the shop? This is the big question. In my opinion, there is no sure-fire, short-cut solution to this problem. It involves carefully prepared long range plans, hard work by all in management, and unlimited patience.

Union Steward. The day-to-day labor relations are made by two very important people—the steward representing the mechanics in your shop and the foreman representing management. The union steward can cause the average supervisor untold grief and irritation, to say nothing of upsetting him to the point of rash action. This is especially true if, as a steward, he is the type who feels the employe is always right and the company wrong. You may not like it, but under law, he is authorized to speak for the workers he represents, and upon due notice from union headquarters, you must recognize him as their representative. Therefore, if you have a union, you have a job of educating the steward. This is an endless task because each newly elected steward requires the same education. Therefore, don't let matters take their course. Plan your educational development of the steward and plan it well.

You may judge the importance of the steward from the union point of view by excerpts from two union manuals. The first is as follows: "The steward is the cornerstone of the union. As representative of the International Association of Machinists in your plant, you are the key man in the relationship of the union to management and the union to its members. The union depends on you for good industrial relations. It is a recognized fact that a union steward who performs successfully the responsibilities with which he is entrusted, is an asset to the company as well as to the men he represents." (From "Manual for Stewards and Committeemen," District 9, International Association of Machinists, A.F. of L., St. Louis, Missouri.)

The second is: "As a shop steward, yours is the job and the opportunity to make this industrial democracy function. You represent your fellow workers in the shop. You are

the noncommissioned officers in the union army. As you carry out your duties effectively, you will represent your fellow unionists well, and the union will have value and meaning for them, and will flourish.

"You are the representative of the union shop. It is within your power to turn a contract from a document of words and clauses into a living protection for the rights of workers. Without you, and others like you, even the best contract is meaningless. You put life in its veins. You make it work.

"Because you are in the shop, in immediate contact with both workers and management, you become the basic foundation of the union. The wisest union leader, the most efficient business agent, cannot build the union and make it function effectively without your help. You must deal with management relating to conditions of work, while at the same time you keep the union strong within the shop so that the boss knows that you do represent the workers." ("So You're A Steward," the Textile Workers Union of America, C.I.O., New York.)

After reading these, there can be no doubt in your mind that the steward is a mighty important factor in the union.

The steward, under most contracts, enjoys "top seniority." The intent of this is to protect him against discrimination in layoffs and to provide for continuity in handling grievances.

Provision for time off for "union business" is part of all union contracts that I know of. There is a difference in companies as to paying the steward. Some companies pay a steward for all meetings with management in the handling of grievances. Other companies pay stewards only for company-called meetings.

Union headquarters require the steward to have a thorough knowledge of the union contract. His most important function is in the handling of grievances. This is so important that in many unions the steward's manual covers in great detail, aids and rules for preparing and presenting grievances. He is coached in items to be covered and instructed in the collection of data to support his case.

Your education of the steward in management problems and responsibilities is a regular day-to-day procedure. First of all, he is a mechanic in the shop with an obligation to perform his regular assigned job. While he has certain rights, he has no right to give orders to your men or to rescind your foreman's orders. Your firmness in bringing him into line will gain the respect of your men, as well as that of the steward. It is possible to maintain your authority and still be agreeable and tactful. A good piece of advice is: Don't talk about your authority—use it with fairness and firmness.

"Stick to your guns" in dealing with the steward. He will try to outmaneuver and bluff you. His demands are usually set high enough to provide leeway for compromise. Get your facts, take your stand. If the steward knows he can't bluff you out of a reasonable stand, he may not like it, but he will respect you. The way you say "No" can make all the difference in the world in the final result.

The foreman's attitude towards the steward paves the way for good or poor labor relations in the shop. Don't try to make a monkey out of him. He will appreciate your help in saving his face in a trying situation. Treating antagonism with antagonism adds fuel to the fire. The handling of a hostile steward is a real test of a foreman's intelligence.

Foreman. If the steward is as important to union interests to the degree indicated by the above quotations from IAM and CIO manuals, the foreman is even more vital to the interests of both management and the men. His vital role in the success and continuity of your operations deserves all the top management attention necessary to be as near perfect in performance as possible.

The man you pick for the foreman of your maintenance shop can have a tremendous effect on your labor relations. You all have seen or heard of shops where there is relatively little labor trouble. Usually, investigation shows that the man in charge knows how to handle labor. Not only does he have a knowledge of machine tools, materials and work scheduling, he also has a good knowledge of human relations. Interest in human relations is primarily an appreciation of the other fellow's feelings and reactions, and the application of tact and common sense to them.

We take it for granted that the man we pick for foreman has adequate technical knowledge and a capacity for hard work. If he is deficient in some phase of the technical part of his job, we give him special training to overcome that deficiency. The course such training should take is usually unmistakably clear. Training in the handling of men, however, is relatively new and not so easily applied. There is the added problem that the training must be "sold" in such a manner that the so-called "brittle" supervisor will accept your help.

The foreman should have a capacity for learning and developing skills in management. This includes not only keeping up with new developments in tools, equipment and methods, but in labor relations as well. He undoubtedly will know his men by their first names, their experience and background. He may recognize naturally that each employe should be handled as an individual. If he is to develop as a well rounded out supervisor, he must try to match his technical skill and knowledge with a sound knowledge of labor relations and the handling of people. The development of such a supervisor is one of management's most painstaking responsibilities. It is fraught with periods of frustration and heartache. Patience and understanding must be ever present in the approach to development of supervisory ability.

We all know that tact and drive are essential characteristics in a supervisor. Tact is the ability to say and do what is best in a given situation, with the intent to avoid offense. It is necessary to recognize that all people have their ego, ambitions, hopes and fears, interests, nerves, and their self-respect. The only way to treat employes tactfully is to consider in advance the effect your words and actions may have upon them. Choose those words carefully and act considerately.

Drive in a supervisor is the abil-

ity to get things done. It does not consist of putting pressure on employes. It does consist of following up work and keeping on top of his own job in getting things done. His primary job is to help each maintenance mechanic to get his job done. If he keeps his promises, if he gives credit where credit is due, if he avoids favoritism, if he admits his own mistakes and takes responsibility for them, and if he is loyal to his men, he has the qualifications of a good supervisor. If his men feel that he represents their interests in management circles as well as he carries the management demands to them, then union or no union, he will have a loyal force to back him up. He must earn this, and this calls for constant effort on his part.

We all know these to be true, but what effort do we make to put them into effect? The average maintenance foreman feels he has a job on his hands to keep machine downtime to a minimum. There are times when this requires prompt and effective action. There's no time for consideration of anybody's feelings. Maybe some shouting and cussing are needed to get the mechanics to move faster. If shouting and cussing are needed, you can be certain the men will expect this on every occasion before they respond. In any shop, and especially a union shop, good mechanics resent this approach even to the extent of upsetting the applecart when they can.

Training Supervisors. In any union shop, effective training of supervisors will pay dividends in the form of getting along with the union. First of all, they should be exposed to actual negotiations of the contract, by participation in the negotiation sessions. Their suggestions and contributions to the negotiations should be sought and carefully analyzed for coverage in the contract. They must live within this contract. The application of seniority, wage scales, union jurisdiction, as well as many other details, has a vital bearing on the conduct of their work. Therefore, they should take an active part in shaping the provisions to meet as much as possible the work requirements of their various skilled trades.

Once the contract is signed, he should become thoroughly versed in its application. He will be beset with all manner of requests from both his mechanics and their steward. The contract may be a "one way street" proposition as far as the union steward is concerned. The steward will hold you to every clause in the contract, but inveigle you into concessions, even those contrary to provisions of the contract if he can. Although the wage scale is part of the union contract, and you are bound by it, the average mechanic will still think you can give him an increase in hourly rate if you really want to. This type of request, as well as actual demands on other phases of union relations, make it not only essential, but imperative, that your supervisor knows his contract thoroughly. Your training should not be confined to giving the supervisor a knowledge of the contract itself. It should take up, for purposes of illustration, the various problems that may arise and the forms the same problem may take. Take time to "spell" these out.

The steward will hold you to every clause in the contract but inveigle you into concessions, even those contrary to contract provisions . . .

In the first place, he must be impressed with the fact that he still is the boss. Foremen are apt to feel that with the advent of a union in his shop, his authority is destroyed. It is true that a union shop does affect the way he exercises his authority. It does not relieve him from responsibility of managing his mechanics and of getting the work done.

The average maintenance foreman usually is more concerned with "how to get the job done," namely, the skills and methods needed. His orders are carried out by skilled mechanics who have an inbred satisfaction in a job well done. With the union, there comes to many employes a feeling of new power. They now have rights. Under this new set of conditions, the maintenance foreman must know his job. This means the entire job, and that includes the knowledge of properly handling his men with their new feeling of "power."

Your training should stress the techniques of effective leadership. The foreman should know his rights and responsibilities, under existing labor legislation. The words "unfair labor practice," tend to intimidate the foreman. Clear the air by spelling out what constitutes unfair labor practices and show your supervisor how to avoid them. Let him know what rights the steward has both under the labor laws and the union contract. Help him develop written records on his men that he formerly carried in his head. Challenge him with the feeling that the new situation with the union in the shop is a test of his intelligence. Give him a thorough training in company policies. Then back him up and help him when he makes a mistake. It may take the legal type mind to draw up the union contract, but, in my opinion, the salesman type is more successful in its shop administration.

Discipline. Discipline is, to my mind, a confusing and misunderstood word. The primary definition of discipline is: To train to obedience, to educate. A secondary meaning is given by the dictionary as: Punishment for the sake of training; chastisement. You can take your pick of these definitions. I dare say the majority think of it in terms of punishment. The employe and his union representative certainly will think of it in this light.

Let us take a look at discipline from the viewpoint of education or training. Discipline is not just for the employe in the ranks. It applies to the head of the department as well. The example set by the top executive sets a pattern for all his supervisors, as well as the men in the maintenance department. The way the head of the department may use or abuse his privileges will establish in his subordinates' minds his status as a leader. They will follow suit and try to take even greater latitude with rules and regulations. Without good example from the supervisor, you can not expect good results from the employes.

It is better by far to avoid the conditions which make disciplinary action necessary. However, when it is necessary, be firm. Don't run away from it. Failure to carry out necessary discipline is damaging to the morale of the entire group. A first

or second warning given to the erring employe is really a service in his behalf. Our responsibility as managers is to correct and save an otherwise good mechanic—not fire him. In this latter case, both he and we lose out.

There are several methods of using warnings as a disciplinary action. One effective method prescribes that a written warning be issued at the level of the management supervisor involved in the incident requiring discipline. If this is done in the presence of the employe's union representative, the union can not claim unfair treatment of the men based on their lack of contact with the case. Every warning should be given in writing.

Cases of discipline of the union employe will be examined in minutest detail by union officials. Both the offense and the punishment will come under their scrutiny. You can aid your supervisor in the handling of such cases by giving him proper instruction and by the development of a consistent procedure. A serious offense, such as stealing, fighting or damaging company property, calls for immediate discharge. Other misdemeanors may be subject to a first warning with or without penalty, and a second warning for the same offense. A repetition may result in discharge.

The serious consequences of these warnings prompt vigorous efforts on the part of the union representatives to have the warning killed. Therefore, it is imperative that the supervisor have the case well documented. Use of other union members as witnesses is not a strong approach in such cases. Reluctance to testify against another union member, or possible punitive action by the union, has a deterring effect on such a witness. The supervisor should spare no effort to have his case well "documented."

If disciplinary action involves discharge, your case must be prepared with arbitration in mind. Nearly every union contract has a stipulation regarding discharge. Usually it requires that no employe be discharged "without cause." It also gives the union the right to file a grievance and, if necessary, bring the case to arbitration.

In discharge cases, make haste slowly. Prepare all phases of your case completely and back it up with all available documented facts. The arbitrator sits as a judge of the case and an interpreter of the law. The employe is innocent until proved guilty. Some companies keep a complete file on each employe. They maintain this as complete as possible with both favorable and unfavorable items of a man's record. Copies are often made available to the union representative. This file is a constructive aid in effectively presenting a case before an arbitrator.

Seniority. Most union contracts provide union officials with special seniority rights. These provisions usually apply to layoffs and recalls, to insure that union officials are laid off last and recalled first.

You will do well to recognize the importance of seniority both to the union and to yourself. It is one of the most important and jealously guarded objectives of a union. It can not be disregarded either in negotiations or in operation, because the union won't let you. Therefore, you must, in negotiations with the union, try to qualify this factor and adapt it to the particular requirements of your plant.

The greater the number of applications of seniority, the greater the limitations imposed on management's prerogatives. Invariably seniority is used to determine the order of layoffs and recalls. Its next most common application is as a factor to determine promotion and demotion within the bargaining unit, filling vacancies and transfers.

Seniority areas are established to administer this provision of the contract. In some companies, plant-wide seniority is provided for. This arrangement permits a union representative or even an employe of one department to displace a member of less seniority in another department. The job shuffling resulting from this can disrupt the work of an entire company. Fortunately, most maintenance departments are set up with seniority areas based on classified skills. This confines the effects of seniority to a limited group of the same classification of skills.

The ability of the employe to perform a given job is a vital factor in seniority problems. This decision should rest solely with the employer. The union may challenge, by grievance, any alleged discriminatory action by supervision. Therefore, it is important to express in carefully worded language what is meant by ability and its bearing on seniority. If you mean skill to perform a given job, say so in unmistakable language and give it due importance.

A desirable modification of seniority demands is the application of seniority to the requirements of the department. By this, I mean that the application of seniority in layoff or recall should be modified by ability of the employe to perform the work. Departmental seniority modified by designated non-interchangeable skills makes for a reasonable degree of flexibility in a maintenance department. This should be "spelled out" in the contract to avoid misunderstandings.

Seniority rights and their application can, and very often do, make trouble for the maintenance supervisor. Therefore, it is imperative that an exhaustive study be made of the needs, problems and effects of seniority on maintenance operations. The required tailor-made provisions should be put in sufficiently detailed and defined language to clarify the rights of both parties to the contract. To the extent that this job is done thoroughly, the disputes involving seniority will be reduced.

Handling Grievances. The grievance procedure is regarded by many management people as one of the most valuable parts of the union contract. It provides a ready means of giving the employe a chance to bring his complaint to management's attention. It gives management the opportunity to take corrective measures, or to explain the situation to the aggrieved man. It does give management an excellent opportunity to do some effective educational work with the employe. He will give you more effective attention during a grievance session in which he is interested than all the notices you can get posted on the bulletin board. As a measure of its value to management, most companies pay union representatives for the time in proc-

essing grievances. The grievance procedure is a good tool to develop good employer-employe relations.

Action to prevent grievances is not only legitimate but intelligent labor relations on the part of the foreman. Work assignments, allocation of overtime, inadequate explanation of changes in procedure or layout of work, poor instruction, and lack of proper credit are some of the basic reasons for worker discontent and grievances. Be a good listener, and many a potential grievance will die while being born.

If the grievance takes form, the foreman usually gets it in writing from the steward. If possible, it should be settled at that step in the grievance procedure. Under no circumstances should the foreman pass it on to the next step without hearing out the case. As a result, he will not only gain time and establish a favorable initial contact, but also get all the steward's story. It may call for a great degree of self control, but a tactful and friendly attitude on the part of the foreman will temper an antagonistic approach by a belligerent steward. His complete presentation of the case aided by the foreman's questions helps supervision to meet the matter on a sound basis. It gives an opportunity to distinguish between opinions and facts. It is so human for most of us to forget this important point and let a grievance get started as an argument rather than a discussion.

The foreman should make good use of the time alloted to him in the grievance procedure. After he has the steward's story, he can take the case under consideration. This method gives him time to get his own facts together, check company policy, check similar cases in other departments, as well as any records bearing on the case. After he has taken these steps, he is in a position to discuss them with his own supervisor for advice. The effective handling of grievances is a most constructive step in development of good labor relations in the shop.

Job Evaluation. Job evaluation is not regarded with favor by union representatives. However, the benefits resulting from job evaluation and its development of job descriptions may be considerable, especially if you have a union shop. In the first place, a sound evaluation system places you in a stronger position during contract negotiations and you have a complete outline of the requirements of each job in the maintenance department. Regardless of reluctance toward recognition of job evaluation by the union, this logical approach to analysis of a job forces the union to a defensive position. It minimizes controversies over job rates because differing viewpoints can be discussed intelligently, since a measure and valuation of the relative worth of all jobs is made available.

Most companies make some attempt to "sell" a job evaluation plan to rank and file employes before installing it.

Work Measurement. The success of any work measurement program in the maintenance department requires accurate and adequate administration and effective support by both line and staff supervision. The union and the maintenance worker must be thoroughly indoctrinated on the benefits of the program. The usual reaction of the union is that it can't be done because of the difficulties in rating the jobs. The system must be installed with detailed methods analysis and an equitable policy regarding limitation of earnings, payment of wages and adjustment of standards. Otherwise, the union will consider it has constructive grounds for opposing all work measurement in the maintenance field.

About the Author

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The foreman is the direct contact with the workers in the introduction of a work measurement program and any additions to it. He is the key man and must develop confidence in the system on the part of the employe. He must be in complete agreement both with the need of a work measurement program and must be a key figure in its development. In this way, he can take a sincere approach to the men under him in presenting the work standards. Their degree of acceptance will be contingent in a large measure on how well the foreman presents the program and their confidence in him.

Incentives. Many unions are unalterably opposed to any incentive plan for maintenance workers. Their stand is based on the belief that the variety of jobs involved makes it impossible to establish equitable rates. Some unions, however, lend endorsement to the use of an incentive plan. Therefore, the existence of an incentive plan in a plant is contingent on the existing relationship between the union and management in that plant. Incentives can be and have been applied successfully to maintenance work. The union will view critically the standards established and the development of the pay formula. To have any degree of success, the details of the plan must be fully known to the union, and this union must have the right of appeal in connection with this application.

Training Workers. A maintenance training program, whether for apprentices, mechanics' helpers, or the mechanics themselves, will come under the critical scrutiny of the union representative. They will check it for conflict with the union contract. One of the chief objections to any apprentice training is the possible loss of work and work hours by union members. The union will want a voice in determining the ratio of apprentice trainees to number of mechanics.

The cooperation of the union is essential to the success of any training program. The degree of cooperation depends largely on how well the program is worked out and absence of conflict with the union contract. # #

In Maintenance Labor—Craft Barriers

Competition is causing a streamlining of work forces. Result—smoother craft relationships, contract maintenance hastens this trend

Harrison T. Brundage, PETROLEUM REFINER Staff

SMALLER PROFIT MARGINS for refiners and the obsolescence of many outdated plants have made mandatory more economical operation, including more efficient use of maintenance personnel. About $1.2 billion is spent annually on maintenance labor in oil refineries and chemical processing plants in the United States. There may be an average of 20 percent idle time for the typical maintenance force. A primary cause of idle time is the uncertainty as to which craft is to perform specific tasks. Rigid adherence to craft lines, resulting in a number of workmen being idled until each such question or dispute has been resolved and the particular bottleneck eliminated, contributes to idle time. Elimination of this type of trouble is gradually taking place in refineries all over the United States, in a number of different ways all designed to alleviate the same problem.

Management is being urged to push coordination of crafts strongly, though quietly, and usually, slowly. Where it is being pushed successfully, it is being done in such a way that the rank-and-file refinery worker stands to benefit by it at the pay table, professionally and security-wise as well. Under the classical AFL organized craft philosophy, strict adherence to the worker's craft was part and parcel of his personal security and to cut craft lines was to cut his own throat. The strongest points with which management can sell relaxation of craft barriers are: (1) greater over-all efficiency, hence higher pay; (2) encouragement of participation in training programs resulting in opportunity for faster advancement, higher pay, and greater interest and satisfaction in the job. Many unions have recognized the advantages to their membership of lowering craft barriers and have cooperated with management to promote such programs. Management's chief means of furthering this trend is thus to show union members what's in it for them and to make it attractive.

The most outspoken criticism of coordination of crafts is apt to come from some big nationwide affiliated union leaders who are primarily concerned with as large a union membership (and union dues collections) as possible. However, their opposition is a delaying action at worst. Continuing reduction of oil company staffs in refineries is inevitable. It appears similar to the trend, now almost completed, wherein major oil companies went from almost 100 percent company drilling rigs and personnel to close to 100 percent contract drilling. This trend began in the '30s and is now virtually complete.

Some Refineries Have Craft Integration. Among major companies, some are well advanced in crafts integration; others have made almost no progress in this direction despite the strong desire of management to push it as rapidly as possible. The same company may have a local independent union in one plant, a local union affiliated with OCAW in another area and still another plant that is not organized. A major company may need to negotiate essentially similar contracts in all its plants; or bargaining may be predominantly on a local basis as reflected by demands of local unions. In some refineries, some maintenance functions are contracted out, in a few cases to nonunion labor.

A big factor in the lack of uniformity is the diversity of the refineries themselves. The maintenance labor setup found ideal for a new modern refinery may be unworkable in an old refinery which has been enlarged, unit by unit, through the years. And the maintenance setup for a plant producing primarily light products is bound to be different from one primarily devoted to specialty lubes and waxes.

"Yard Man" is multi-skilled mechanic. In one major company plant in West Texas, a "yard man" is recognized by both the union and management as a multiskilled mechanic, much valued because he is used on small jobs which he completes by himself without having to call in each craft involved. In certain other refineries, such multiskilled mechanics cut across craft

Are on the Way Out

lines, each being assigned to one of several intra-refinery designated zones. In still another maintenance setup in which jurisdictional lines are strictly adhered to, the "yardman" is assigned to the labor division, on a parallel level with labor pushers and the building maintenance man.

Who erects scaffolding? Evolution of new refinery maintenance techniques and materials, and different and larger type units also tend to outmode the classical disposition of crafts. For instance, during a turnaround on Tidewater's Delaware cat cracker, two days are required to erect scaffolding and two more to dismantle it. For any big shutdown, scaffolding is always erected by carpenters. However, when the job is finished, all workmen pitch in to help dismantle scaffolding. Catalytic Construction Company, the maintenance contractor, has been very successful in getting agreement with the AFL to allow its employes to cut across craft lines in extreme emergencies, although craft jurisdictions are maintained as much as possible.

Scaffolding itself is apt to pose a jurisdictional problem, under a craft-conscious setup. Wooden scaffoldings should normally be handled by carpenters. But nowadays many scaffoldings are of the "erector set" type, composed of a pipe assembly readily put together, taken apart, and reused as is. Is this carpenter work? Hardly. Pipefitter work? Why not laborer work? Refinery techniques and units change, and use of maintenance labor must thus change with them.

Maintenance forces are being reduced. There is no question that the gradual attrition of refinery maintenance workers will continue, with many workers lost through retirement, death, resignation, and other causes, not being replaced. In the future, refineries may be almost fully automated. In addition, contract maintenance has proven its effectiveness and may become more popular, particularly in new plants. Proponents of contract maintenance expect not only 100 percent contract maintenance in many refineries in the future, but foresee 100 percent contract operation in some cases as well. So the dies are cast; the only question seems to be "how fast?"

It is probably best to strive for a happy medium between rigid craft limitation and making every maintenance mechanic a jack-of-all-trades. It is in neither labor's nor management's interest to have maintenance mechanics who are thus "masters of none." Also, there may be some cases in which a rigid craft adherence is in management's interest as well as labor's, e.g. where extremely dangerous and/or explosive materials are being handled in small pressure vessels, and absolute safety is a life-and-death matter. So the answer to the question, "how far can I go in craft coordination?" is probably "how far should you go?", and depends primarily on the local situation in your refinery or petrochemical plant.

Much depends on what you are starting with. In some refineries, crafts are broken down minutely. "Spray painters" and "brush painters" are separate classifications. Grievances are apt to arise if management tries to assign paint scraping as a laborer's chore, instead of paying painter rates for it. In other refineries, work classification simply haven't gotten that complicated, so the problem is less severe. One major company has had the classification "steel erector" for many years, inferring a very generalized refinery craft. Another began training an elite corps of all-purpose mechanics 20 years ago, and is now in a position to coordinate pipefitters, boilermakers and riggers into a single work classification in one of its major refineries. This highly-trained group is much respected among other personnel.

Many workers dislike rigid crafts. It is probably true that many refinery maintenance workers dislike a rigid craft breakdown and dislike the inefficiency it is apt to engender if overdone. Many may wish for a better opportunity to learn new skills than a straight seniority system allows. Many workers realize that inefficient operation costs them, too, in the increased pay that may be denied them because their plant is not competitive. And doubtless many workers may be tired of becoming involved in ludicrous grievances, e.g., whereby a sign-painter may be criticized by a carpenter steward for driving in several nails to re-erect a repainted sign.

Stewards are easier to deal with. As craft barriers are gradually eliminated, it should be easier for foremen and superintendents to deal with union stewards. One of the steward's prime functions is to represent members of his department in grievance cases. Often, these grievances involve crossing of craft lines. As managements and unions work toward lowering of craft barriers, grievances should be progressively less frequent. A steward must be competent in his work, as well as representing members of his group in union matters. Hence, a steward who earns a reputation as a trouble-maker is apt to let his work slip and can usually be put back in line through justifiable disciplinary action. If craft coordination can be done in such a way that general morale is improved, grievance cases should be fewer and stewards easier to deal with.

The subject of craft coordination and integration is a very touchy one, and oil companies are generally reluctant to discuss it. They are even more reluctant to be specifically identified. Thus, it is difficult

to acquire as thorough an analysis of craft integration progress as is desired. However, a few programs have been publicized somewhat, and some interesting details have thus been learned. Refinery management men are generally agreed that idle time caused by jurisdictional bottlenecks must be eliminated. But many different approaches to the problem are being suggested, and there is considerable disagreement as to the merits of certain approaches.

Esso training program gives young men a chance. An interesting training program is being conducted by Esso Standard Oil Company at its Everett, Mass., refinery. A joint union-management program, instituted in August, 1956, was designed to mitigate the shortage of first-class mechanics. Previously, lack of seniority usually meant lack of opportunity for younger employes who were confined to lower classifications and pay rates regardless of ability. Though the new program gives first consideration to high-seniority employees in accordance with virtually all union contracts all over the country, the program nevetheless permits low-seniority employees to do first-class work at first-class pay.

A five-man "Joint Mechanical Trades Training Advisory Committee" was formed, composed of two union and two management representatives plus the plant's training supervisor who worked in a non-voting capacity on the committee. The group administers the refinery's training program. The program consists mainly of on-the-job training and classroom study, with trainees on salary. Instruction is offered in ten basic crafts: boilermaking, welding, carpentry, masonry insulation, painting, electricity, instrumentation, mechanics, pipefitting and rigging. Plant foremen have evaluated all work, progressively upward from the easiest to the most difficult jobs. Trainees are placed at various job levels so as to work and train at top performance level. Each trainee's performance is evaluated monthly and those making a determined effort to master a craft are retained in the program. On-the-job tests are conducted to determine progress and to allow a man to bid in for a job in a specific craft. There are after-hours classes at company expense for those employes requiring study in mathematics and blueprint reading. Every six months, the trainees who qualify progress a step higher toward achieving first-class work at first-class pay. Beginners can reach the first-class rating in five years (insulators and painters in three).

Although the Everett program is not a craft integration program *per se*, it does develop more highly-skilled mechanics, provide incentives, improve morale and result in fewer grievances.

Craft integration a fact at Bayonne. Integration of crafts is apparently much farther along at Esso's Bayonne, N. J., refinery than in many other East Coast plants. Here maintenance is done in a zone supervisor system. Eash supervisor has a dozen men representing each necessary maintenance and construction skill with the exception of instrument men and electricians (provided by another refinery division). Area crews are divided into three classifications; helper, second class, and first class maintenance and construction mechanic. In time, most of the men are expected to attain first-class status.

Any maintenance job that arises in their assigned areas are done by these crewmen, without regard to craft lines. At Bayonne, the concept of a refinery mechanic has been developed to mean, "a worker

A Panel Discusses Labor Problems

A panel discussion on Labor Relations in Union Shops, held at the National Plant Maintenance and Engineering Conference, Cleveland, January 26-29, 1959, revealed these ideas on labor relations.

Labor Costs. General labor relations are becoming harmonious *at an increasing labor cost*. One refinery estimates that fringe benefits amount to 22 percent of the worker's base pay. The cost of time not worked is increasing. These latter costs include such things as an increasing number of holidays, jury duty, sick leave, smoking privileges, and death in the immediate family.

Qualification. One refiner reported that the contractual requirements for a craftsman to be tried in the next higher job is dangerous because the union will close-in around him and not let the supervisors take him off the job. In one case, a terminal gauger had a poor performance record. Even the union agreed. So, the company refused to promote him to the next higher class. The gauger filed a grievance but during arbitration, the members would not testify that he was unqualified for the job.

There seems to be a solution to this situation and that is to establish a *good objective* qualification program. The unions will go along with a good program and you will not be put in the position of having to promote a man who is recognized as unqualified for the job.

Another solution suggested was a frank talk between the man and his supervisor about his qualifications. One supervisor suggested that if you simply ask the man questions about the job that nine times out of ten, he will end up saying he knows he's not qualified. Many will quit voluntarily but it was thought that if the man is not given a chance to quit that you may face the possibility of a tough grievance case.

On the subject of temporary upgrading, one discusser thought that it would be dangerous to assign second-class mechanics to do first-class work on a temporary basis because the unions will look on this as recognition of his qualifications and will demand first-class pay.

Shift Work. The unions generally try to get the old hands on day shifts. One panelist thought that you

skilled in at least one craft, but able to perform virtually all types of semiskilled maintenance work." Esso has experienced greater efficiency, amounting to about 20 percent improvement in maintenance and construction operations.

Western Refinery Reorganizes Its Maintenance Program. An interesting reorganization program has recently been undertaken in a refinery in the western part of the United States. Previously, the maintenance organization was of the conventional type, broken down primarily by crafts to serve the entire plant. Under the new setup, the plant was divided into two zones each headed by a general foreman, with each zone divided into three maintenance areas under supervision of an area foreman. The area foreman directs all maintenance craftsmen assigned to his area and is also the timekeeper, among other duties. Individual area heaquarters were developed for each area foreman, existing building being available in most cases. Requisitions were made for special area tools, radio call system, office furniture and printing equipment, and some craft shop facilities were consolidated. Strong efforts were made to develop a good educational program. In a series of meetings, all engineering and research department technical personnel and operating and mechanical division supervisors were taught details of the proposed new setup and were issued procedure manuals. Mechanical division supervisors were further briefed in additional meetings on their new responsibilities and procedural details. Just before the reorganization went into effect, a series of meetings was held with hourly employes in each craft in the mechanical division to explain the new organization.

After about six months of operation under the area system, a preliminary evaluation of the new system was attempted, with both advantages and disadvantages listed.

Advantages. On the plus side, supervisory responsibility was better defined than before. Closer contact between supervisors and the work force was experienced. Better coordination between mechanical and operating supervision was experienced in maintenance work. Also, there was better control of material. Planning and scheduling were better. Personnel problems were pinpointed, and better and more thorough craft improvement training for certain individuals was developed. Better morale and job interest was seen among maintenance

must impress on the unions that the night shift may be critical in the process industries and that if all the men are inexperienced, the result could be disastrous.

Many unions want men to work in pairs. It was thought that for dangerous jobs, such as electricians, this would in many instances be a good rule. But, it can be carried to extremes. In one plant there was only enough night machine work for one man. The union insisted on using two machinists. The plant agreed but stated that they intended to hookup a closed circuit TV for the night supervisor. The union promptly dropped the request.

Stewards and Foremen. One important step that the maintenance supervisor can accomplish is to get the steward to work with him instead of bypassing the supervisor and going to the industrial relations department. But, the foreman should certainly never make an under-the-counter deal with the steward between contracts or he will have that foreman "beat" as long as he's on the job.

If the steward knows he can't bluff you, he may not like you but he will respect your decisions.

One of the panel members said that it is imperative for the superintendents to take the foreman into their confidence before labor negotiations take place and not afterwards. Another foreman's suggestion was to have the industrial relations department cover the contract article by article with the foreman, telling them what points are an advantage to the company and which are to the advantage of the unions.

Grievances. If an AFL member has a grievance, his first step is to go to the foreman, or both he and the steward will talk with the foreman, first. If the difficulty can't be straightened out, the grievance is put in writing. This is not true with the CIO. They insist that the grievance be put in writing immediately. Of course, the AFL has more initial grievances because they are verbal but most of these are settled without becoming a formal grievance.

One refinery has a monthly agenda meeting before which any complaints can be lodged. If the union doesn't like the company's solution at this meeting, a formal grievance may be filed. However, between the years 1954-1958, only one grievance has been formally filed.

It was stated that the CIO supports mediocrity and that they will argue a grievance for any reason. In the speaker's opinion, the AFL will not do so because they are proud of their skills, and in particular, grievances over upgrading of a mediocre worker seldom occur because the union talks the man out of trying to be qualified.

Nonunion Workers. One refiner reported that 20 percent of his workers were nonunion employees. The union handles the grievances for these workers and are very fair about handling them. Of course, this is good publicity for the union to get these workers to join.

Discipline. One panelist reported on a discipline system used at General Motors during the war and at North American Aviation Company which might be applied to the process industries. These companies have a list of 58 company rules and penalty points corresponding to the violation of each rule. The accumulation of 100 points by an employe is grounds for immediate dismissal. However, the employe can work off 10 points every 6 months. For example, maintaining an unsanitary condition has been assigned a value of 10 penalty points. Insubordination, 20-100 points. Absence for five days without notifying the plant, 100 points. The penalties are assessed by the foreman and are kept in the employe's permanent progress report.

The system is working satisfactorily for North American Aviation and gives the foreman some means to discipline the chronic rule violator working in his group. ##

personnel. Operators are able to participate more in job planning and scheduling, because of strict adherance to a job priority system. Cost consciousness tends to improve. Perhaps most significant of all, craftsmen report directly to area headquarters to start each shift, thus more time is spent on the job.

Disadvantages. Based on the same limited experience, a number of disadvantages were also related. Area foremen were not familiar with each craft's work, and thus were handicapped in their ability to supervise unfamiliar functions. Some foremen were reluctant to avail themselves of special technical assistance from the special shops and crafts department offered in such circumstances. Mechanics felt out of place working outside their previous crafts, and had some difficulty in adjusting to working under several different supervisors during the same week. A locker room problem developed since craftsmen assigned to field work no longer reported to their craft headquarters. A central locker room for all craftsmen, located at the refinery gate, was recommended as a result of this experience.

In addition, craftsmen had previously tended to become overspecialized, and were not well rounded enough to perform their new expanded duties satisfactorily in all cases. A training program was to be developed to mitigate this problem.

Supervisory replacement problems owing to vacations, sickness, and other absences were more severe under the new system.

A radio paging system was felt to be essential in addition to the plant radio system, since the new system demands better communications among maintenance and operating personnel.

Generally, however, the refinery's management is encouraged with the results of the new setup. Most of the problems appear to be soluble pending development of a more thorough training program and more prolonged experience under the new organization.

Impact of Contract Maintenance. A definite trend may be developing toward contract maintenance of specific types of equipment, such as heat exchangers, boilers, etc. An increasing number of engineering contracting firms are showing interest in entering the contract maintenance field. In the older, conventional type of craft-aligned maintenance setups, usually only incidental maintenance such as brickwork, was contracted out. Other less specialized work, such as painting, is perhaps being contracted out more commonly now, but these items are much less significant than the breakthrough in craft lines being made in contract maintenance. The need for flexibility was stressed strongly during World War II during turnaround, when labor tended to be sorely short.

In the postwar era, Catalytic Construction Company through ability to offer steady employment at construction pay rates to many maintenance and construction workers willing to go where the work takes them, has achieved agreement with about 15 international AFL craft unions to allow crossing craft lines. When necessary in extreme emergencies, boilermakers do pipefitters' work and vice versa. The agreement with the international AFL unions had also been successful in preventing strife between Catalytic's men and craftsmen in local refinery unions, as of the end of 1958.

Unions supply hard-to-get workers. The AFL craft unions have been extremely helpful in providing hard-to-get skilled workmen on short notice. First class welders are particularly difficult to hire on short notice. Hence, virtually any large-scale contract maintenance will involve union labor simply because only the unions can provide the men. In a few cases, small specialty contract maintenance may be provided on a non-union basis, but never on a large-scale basis. Cooperation and participation of the unions are essential in any large contract maintenance project.

As contract maintenance evolves, companies participating in it will serve a greater variety of industries. In addition to maintaining several refineries and petrochemical plants on a contract basis, Catalytic does all the maintenance for a cement plant in Ontario. Such an arrangement affords an even greater variety of skilled labor available on short notice than if Catalytic restricted its operations to petroleum.

Small management force directs Tidewater's maintenance. At its Delaware refinery, Tidewater has a small management force (about ten men) to direct maintenance. This group consists of a manager and an area coordinator for each of the three areas into which the plant has been divided. Catalytic's contract maintenance setup under Tidewater supervision has been described rather thoroughly in previously published material. The fact that an area type approach has been taken to the maintenance of this ultramodern refinery may be significant in determining future trends in maintenance labor utilization.

However, the zone system at the Delaware Refinery is essentially limited to supervisory personnel only. All workmen are in a pool and assigned as shutdowns occur.

Objections to Zone System. There are strong objections to a zone system in which workmen are assigned permanently to a specific zone. Where this occurs, workmen in one zone may be overworked, while those in another may be idle. Some union agreements may prohibit shifting workers from one zone to another. Also, a zone system may cause supervisors to select the best men out of the labor pool so that only less efficient workers are available from the labor pool at turnarounds or in emergencies.

Maintenance Cost Reductions Are a Must. Costs being what they are, it has become virtually a necessity that refineries find ways to reduce maintenance costs. Either the work must be contracted out or crafts must be consolidated for increased efficiency. If the oil companies wish to continue to operate their own maintenance organizations, they must also find ways of consolidating crafts and streamlining their organizations so that their over-all operations are competitive. There is much to be done and money to be made in this area. ##

Can Consultants Help Your Maintenance Program?

"Management sometimes wonders if the outsider is looking for technical knowledge and know-how or if he is really there to measure their efforts"

H. W. Shockley, Maintenance Consultant, Wilmington, Del.

Q. *Mr. Shockley, just what is a maintenance consultant?*

A. A maintenance consultant is both an engineer and an administrator with broad experience in plant organization, processes, procedures, costs and controls. Above all, he must know people and realize his job is as much a teacher as an analyst. In other words, he must get people to work with him, get their ideas, utilize their energies and knowledge and, above all, assist in the development of a program so they feel that they have had as much to do with it as he has. Experience has proven many times that a poor program properly developed will result in greater application and give better results than a well developed program improperly applied.

Q. *If this definition is true, why are consultants not used to a greater extent in refineries and petrochemical plants?*

A. Quite frankly, from my own experience, it may be due to the following: poor promotion, management's concern of outside help, past experience in the use of so-called "experts," management's unwillingness to spend the money, unwillingness to accept new ideas or lack of knowledge as to the benefits which may be secured.

Q. *How does the consultant show that his services can cut maintenance costs?*

A. For an outside consulting firm to come into a plant with which they are not familiar and state what they can do or save is pure fallacy. They must present some ideas that could be used to get a general measure of performance. To do this, they will request certain data or suggest that a preiminary study be made. The study will summarize the major probems and indicate the program of approach that could be used to the best advantage of the plant, personnel and operating conditions. The preliminary survey indicates not only what is necessary but the degree; and it will cost management much less money in the end.

An index which I always try to use is this chart (see Figure 1) which covers the following factors:

1. Total plant investment (annual)
2. Total annual maintenance costs.
3. Total production.
4. Units of production per maintenance dollar.
5. Engineering news construction index.

These factors are shown on the chart as:

1. Annual investment.
2. Maintenance cost as percent of investment.
3. Total annual production.
4. Units of production per maintenance dollar.

The correction factor is used on maintenance dollars for units of production per maintenance dollars only, in order to have them comparable.

The chart is usually plotted for a period of at least five years. If units of production per maintenance dollars are on the increase, costs are at least holding their own. If increasing faster than production, cost reductions are being made. If decreasing, even though production is either increasing or holding level, maintenance costs are increasing.

The investment and maintenance cost as a percent of investment is shown to indicate:

1. If maintenance is improving, are capital dollars being spent to secure it?
2. If investment is steady and maintenance less,

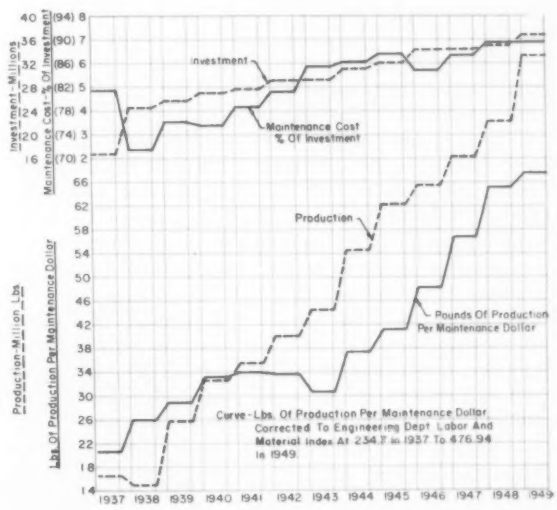
Investment - Millions
Maintenance Cost - % Of Investment
Production - Million Lbs
Lbs. Of Production Per Maintenance Dollar
Investment
Maintenance Cost % Of Investment
Production
Pounds Of Production Per Maintenance Dollar
Curve - Lbs. Of Production Per Maintenance Dollar Corrected To Engineering Dept. Labor And Material Index At 234.7 in 1937 To 676.94 in 1949.
1937 1938 1939 1940 1941 1942 1943 1944 1945 1946 1947 1948 1949

FIGURE 1—If units of production per maintenance dollar are on the increase, costs are at least holding their own.

maintenance cost as a percent of investment will be less.

Q. *Why do some companies use consultants to review their maintenance program instead of using their own personnel?*

A. The reason many large organizations have been successful in promoting the use of the latest engineering techniques in their companies is through the use of outside consultants to review their checks and balances and to look very critically at their methods and programs with an outside eye.

It might be apropos to outline what a probable improvement program would cover. This is, of course, based on the type and kind of plant, particularly as to what programs they have covering good maintenance control. However, an example might be:

1. Organization study (line and staff).
2. Procedures for best work execution.
3. Shops and tools.
4. To what extent preventive maintenance is necessary.
5. The scope of corrective maintenance.
6. Training necessary for both supervisory and wage roll personnel.
7. Cost controls.
8. Inventory control of maintenance materials, spare parts and extra machinery.
9. Measurement of performance.

Q. *Do you feel that plants are reluctant to allow an outside study of their setup?*

A. It is perfectly normal for management to look critically at "consultants" entering their plant who are unfamiliar to the personnel. Management sometimes wonders if the outsider is looking for technical knowledge and know-how or if he really is there to measure their efforts. No consultant worth his salt is interested only in measurement. He usually wishes to use plant personnel to the greatest extent possible for accumulating data and analyzing the studies. More pertinent, no right thinking consultant would want to make any study unless management was willing to advise their personnel as to what was taking place.

The problem of the consultant is not only to be assured that results are secured but that whatever programs are installed can be easily applied and maintained by plant personnel after he leaves. This is the most essential reason for utilizing plant personnel.

For example, it has been found expedient to establish training programs for all classes of skills in many industrial plants. This training is first taught the supervisors who, in turn, teach their own personnel. In this manner, management can very quickly obtain a measure, not only of the scope of wage roll skills, but also supervision's ability to properly supervise and teach.

Training programs covering wage roll personnel for both maintenance and construction skills are usually divided into two parts:

Part 1. Job Fundamentals. The material includes:
- a. Shop math.
- b. Measurement.
- c. Hand tools.
- d. Power tools.
- e. Blue print reading.
- f. Field sketching.

Part 2. Job information pertinent to the particular plant:
- a. Packing and gaskets.
- b. Valves.
- c. Pumps, bearings and couplings.
- d. Mechanical seals.
- e. Compressors.
- f. Lubrication.
- g. Materials.
- h. Electrical and instruments.

In both the teaching and application of procedures, controls, etc., which constitute supervisory training, engineers are trained to do this, and by this means it is assured that results permeate the whole supervisory organization.

The real basis of any study is to more thoroughly train personnel in the best administration, job and improvement techniques. They must be conscious that eternal vigilance is the price of success and unless they keep informed and both know and act, nothing better will be accomplished. However, they must have an improvement program suitable to their own plant and conditions. This can oftentimes be established best by an outside consultant who is willing to face the facts rather than the personnel within the plant.

Q. *Isn't the maintenance consultant only a new name for an efficiency expert?*

A. Many companies have had sad experiences through the use of so-called experts or consultants which, in some cases, resulted in doing nothing more than upset organizations, provide voluminous reports which aided nothing and established overhead that yielded nothing but high costs. However, the days of the efficiency expect are over, and while much mischief was done, another very important factor has been added to industry that was not so important then—that is high costs. As long as industry is in business to make a profit, and high costs reduce profits, management must be constantly aware of different and new approaches even to the same subject, and in many cases this is available in reputable consultants.

For instance, the laborious methods of writing orders by hand, adding cost codes and indicating the type of repair necessary have been replaced by tabulating equipment which not only reduces waiting time but indicates much clearer what must be done and makes possible a clear record of these items. Also, machine conditions can be determined electrically and transmitted immediately by telephone.

In addition, the supermarket idea can be made applicable to stores whereby parts can be easily secured and accurately recorded, whether by the mechanic teams or by planners for these teams.

Q. *Will not the consultant's fee contribute to increased overhead?*

A. There is probably no expense of industry that is more loathed by plant management than overhead. Its increasing cost each year is a constant plague on their profits. When outside consultants are brought in, overhead is definitely increased. However, the use of outside consultants may even reduce this plague if used properly. For instance, experience over the years shows that for every dollar spent on a constructive maintenance improvement program, three have been returned where the proper approach was made. In addition, downtime of operating equipment has been reduced. Preventive maintenance introduced wherever possible has resulted in a reduction of repairs both in size and volume and has also indicated every weakness in equipment operation and need of repair.

For instance, it is known that properly kept equipment records covering all repairs to industrial equipment is the only true way of knowing whether such equipment is worth maintaining or should be replaced.

However, it is quite obvious that these equipment records cannot operate properly without three major factors, namely: an effective work order procedure, work order costing, semiannual or annual reports of each equipment piece.

These reports give two methods whereby further analysis is indicated, namely; maintenance cost as percent of investment, and labor and material ratio.

If either is higher than the industry's average, proper analysis and corrections should be made as to materials of construction or methods, or both. This is the development and corrective area where engineers are most useful; and it is here that the consultant's experience is of vast aid to management as to number, scope of work, programs, organization required, etc.

While it is within the limits of a plant to establish these records, experience has proven that a consultant can have them established much faster, and in the end they will be more accurate, and their use will be better understood. Another instance of our teaching principle.

In past years, consulting costs may have seemed high; today it is low as related to reduced unit cost of product, if applied properly. Today there is no need of large outside talent delegations to entail both plant confusion and high cost. Plant personnel is the answer. This is not only a basis for securing better results but is a means to measure their performance as well as carry on the program continuously and aid in its proper termination.

Unfortunately, a more costly approach than by the use of outside consultants is still prevalent in many industries, particularly the smaller ones. Works engineering and maintenance organizations still function without sufficient personnel to meet the various categories of plant operations, without even considering the staff assistance necessary for control, improvement, etc.

Q. *What are the real benefits gained by using a consultant?*

A. One of the greatest weaknesses that has prevailed in the field of maintenance and construction has been an accurate measure of results. This has been further affected because of the belief that it was not necessary to maintain the records and costs required to give these results in the repair and maintenance of process equipment and facilities. However, when it is understood that today it requires from $25,000 to $30,000 for tools, equipment and facilities per mechanic, it is very important that the latest engineering methods, techniques, tools and equipment be available if this capital account is used to the greatest advantage.

While experience shows that many industries went overboard in the last few years in securing more engineers than they should have, in most cases this was due either to their lack of knowledge of present and future work load, or in having an improvement program that was definitely established for their men to work on, or they were lacking in proper works engineering or plant engineering line and staff organization.

However, whether a part of the plant administrative organization or part of an improvement or development program, it is essential that sufficient engineering skills be available if best results are to be had in any plant.

Q. *Does this need for consultants apply to small plants with limited budgets?*

A. Because of location, operating conditions and sometimes even the product manufactured, small concerns in the past could operate on lower overall costs than the larger ones. The particular type of product and marketing conditions sometimes also helped.

Today that has changed; there is no successful product that can long be noncompetitive. Wage scales are becoming more general throughout the U.S. Unions are fast covering all sections.

The net result is that all companies, whether large or small, must operate under the same conditions. If the small company thinks they can function differently, or not need the same services or controls as the larger company, they are only deluding themselves. This condition is probably most prevalent in the engineering field, which in many cases is least understood as to its functions and responsibilities by management. There is where the consultant can be of great value. His study and analysis can very quickly indicate to what degree technical skills and engineering techniques are necessary, and can offer constructive suggestions that will allow any size plant to function to its greatest advantage, and include what is required in the way of organization, equipment and facilities for the plant to perform efficiently at lowest costs.

About the Author

H. W. Shockley received his B.S. degree in mechanical engineering from Lehigh University in 1918. Shortly after graduation he went to work for Virginia Alberene Stone Co., where he became plant engineer and assistant to the plant manager. For the past 31 years, however, he has worked for E. I. duPont de Nemours & Co., spending five years in development and experiment, four years in maintenance, and the final 22 years in maintenance consulting. In his present position, Shockley is a consulting assistant where he aids all Du Pont plans in improving maintenance performance.

Good Housekeeping Can Pay for Itself

A good housekeeping program is one prerequisite to an efficiently operated refinery. Without it, you're asking for accidents, loss of products and higher costs

C. D. Hull
Continental Oil Company, Ponca City, Okla.

FOR MANY YEARS Continental Oil Company's management has recognized that the principal controls in the operation of an efficient refinery must include safety, good employe morale, high throughput, and optimum product yields and quality. Good housekeeping is one of the prerequisites of a well rounded program in achieving these objectives; therefore, it is Continental's policy to maintain a high standard of housekeeping not only at its Ponca City refinery but also at other plants and facilities located throughout the country. There are many facets of good housekeeping, some of which are discussed here.

Plant Arrangement and General Conditions. Much of Continental's Ponca City refinery was originally constructed with pipe lines installed underground; however, this was subsequently changed by placing substantially all lines overhead on stanchions, which materially reduced physical loss of products and maintenance costs and improved housekeeping conditions. Substantial expenditures have been made to provide all-weather roads to operating areas, tank farms, and other locations where mechanized equipment is essential in the transportation of personnel and materials. This saves time and expense of such equipment, improves mechanical working efficiency, and contributes significantly to the cleanliness of the plant.

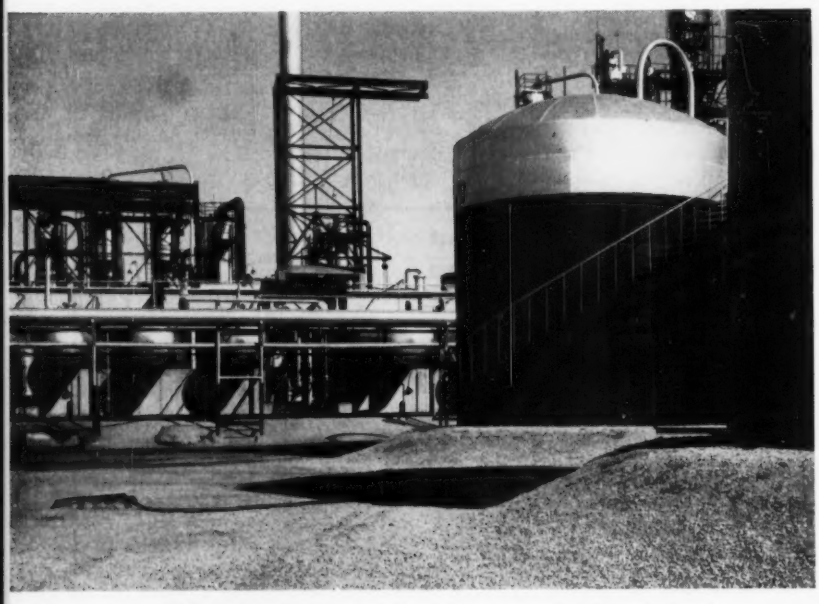

FIGURE 1—Run-down tank areas are covered with crushed rock.

In operating areas where run-down tanks are not protected by dikes, the soil is treated with oil and chemicals to kill weed growth; and the areas are then covered with crushed rock (Figure 1). Spills or leaks of heavy oils are readily cleaned up by replacing the crushed rock. In areas where light oil spills or leaks occur, the cleanup is accomplished by water-washing the loose rock.

A mechanical street sweeper is used to remove dirt and other materials which accumulate on the pavement (Figure 2). Disposal of this debris before it reaches the sewer systems helps eliminate the possible plugging and costly cleaning of such facilities. Removal of dirt and debris from the streets decreases the blowing of fine particles into rotating equipment where it could create

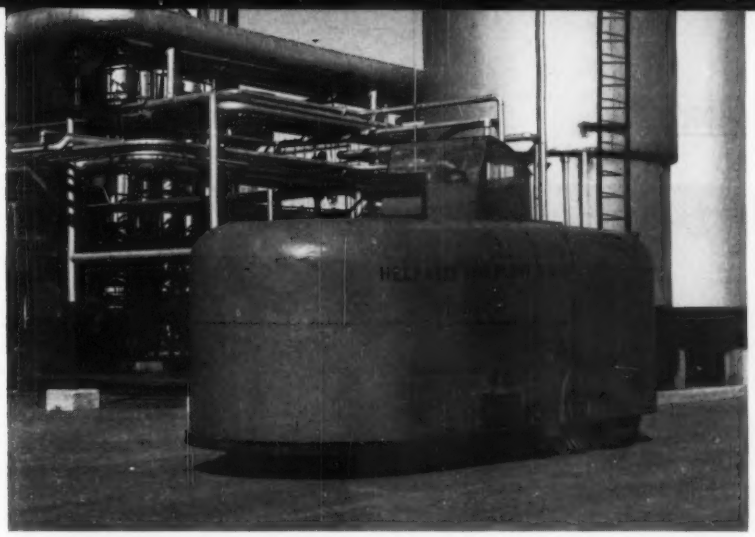

FIGURE 2—Mechanical street sweeper keeps blowing dirt out of rotating equipment.

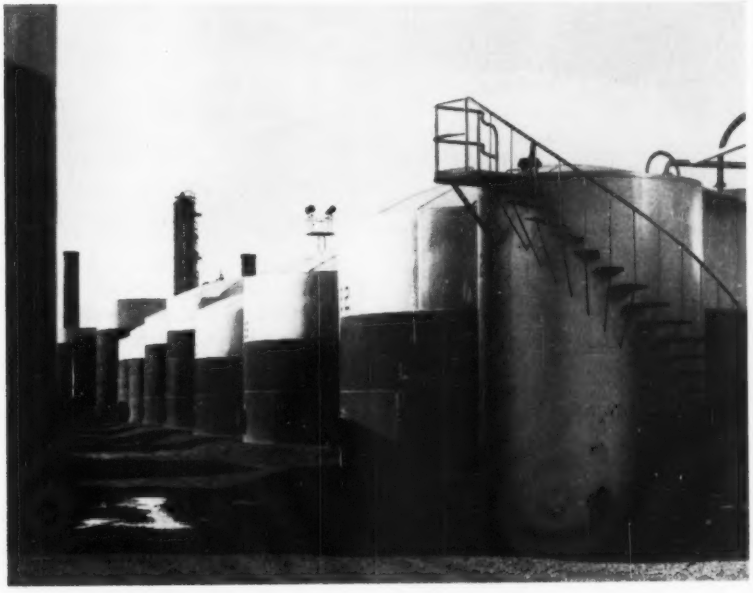

FIGURE 3—Aluminum and black color scheme has been adapted.

housekeeping problems and possibly cause failure of equipment. Likewise, it decreases the possibility of foreign materials being blown into the eyes of employes requiring first aid treatment and possible loss of time.

Painting. The painting of buildings and equipment in the refinery is primarily for appearance; however, there are some areas which require painting to preserve the surfaces. All facilities are continuously and closely scrutinized, since it is frequently more economical to paint when only one coat is required in preference to allowing surfaces to deteriorate to a point where priming and possibly two additional coats are required. Continental has standardized on certain colors for specific types of equipment. For example, towers, exchangers, and other equipment in light oil service are painted aluminum (Figure 3); while pumps, lines, and equipment in heavy oil service are usually painted black. Exposed pipe lines are painted black; however, those handling volatile materials are generally painted white.

Receptacles are strategically placed throughout the plant in which papers, cardboard, food scraps, discarded containers, and other rubbish are placed. A conventional self-loading trash truck is used to pick up such refuse (Figure 4). This rubbish is hauled to a disposal area for burning, and the residue is placed in a pit and covered with dirt.

Locker and office buildings, laboratories, and rest rooms are maintained by plant janitors who are also responsible for cleaning and waxing of floors including process unit control rooms.

Instilling Good Housekeeping Practices. Methods used for many years to educate and instill in the minds of operating, mechanical, and supervisory personnel the soundness of good housekeeping practices include:

- A program of preventive maintenance of equipment
- Regularly painting equipment to maintain good appearance and avoid deterioration
- Quickly repair leaks—such as: pump glands, valves, flanges, steam lines etc.
- Provide modern housekeeping tools, equipment, and materials
- Frequent mowing of tank farms and grass covered areas
- Provide suitable receptacles for discarded papers, cardboard, rags, food scraps, and other waste materials

To keep the program functioning satisfactorily, these practices are discussed in meetings and on the jobs with supervisors and employes at frequent intervals.

Operating and mechanical personnel have worked under good housekeeping conditions for many years, and on occasions they call management's attention to dirty or carelessly maintained areas which may have gone unnoticed for a short period of time. It is believed that this constitutes good employe-management relations and indicates the degree of interest employes have in maintaining a clean and orderly plant.

A good housekeeping program requires teamwork, and there must be full support from all levels of management and employes. If there is a key person in such a program it is probably the front line supervisor, since it is his responsibility and duty to see that cleanup is one of the first orders of business; and he must be fully supported by management in his housekeeping decisions.

All employes have a part in our housekeeping program—operating personnel are assigned certain routine duties in keeping their areas

FIGURE 4—(Above) Strategically located receptacles are emptied into a self-loading trash truck.

FIGURE 5—(At right) Portable tool boxes make it easy for craftsmen to start the day with his tools at the proper unit.

clean and orderly; mechanical personnel are required to clean up their areas of work at the end of each day or upon completion of a job; and, in addition, they are required to keep their tools and equipment clean, in proper order, and stored in tool boxes when not in use. Tool boxes are strategically located to permit each craftsman to start the day's work without the necessity of spending time looking for such equipment (Figure 5). Tools are frequently returned to the main toolroom for cleaning, inspection, and repair, or are replaced when deteriorated to the extent they might cause accidents or result in poor workmanship.

Is Housekeeping a Day-to-Day or Periodical Effort? Maintaining a high standard of housekeeping in a refinery is a continuous, day-to-day, and month-to-month job. To permit deterioration over a period of time then resort to a "crash cleanup program" for restoration of the plant to an orderly condition is highly unsatisfactory. It results in excessive expense and employes generally lose interest in such a program.

Optimum Housekeeping Standards. We have no specifically defined optimum level of refinery housekeeping standards, but all personnel are well aware of the policy of maintaining plants and equipment in a good state of repair and cleanliness. We believe employes prefer a clean place to spend their working hours and are receptive to helping maintain a high standard of housekeeping. It is our opinion that if employes become accustomed to maintaining a clean place to work, they point with pride to their place of employment, the feeling becomes contagious and will be reflected throughout the community in well kept homes, clean streets, beautiful schools, churches, and parks. This is conducive to good neighbors and improves the company's public relations. Such an attitude on the part of employes has a material bearing on the optimum level of housekeeping standards in the refinery.

Is a High Standard of Housekeeping Expensive? Continental is frequently asked how much extra a high level housekeeping program costs. One cannot answer this question with definitive figures. It is believed, however, that there are many intangible advantages which ultimately result in lower over-all operating expenses. Some of the factors are higher morale of employes, fewer accidents, fewer fire losses, less spills and waste of products, lower maintenance cost, better place to work, and improve public reations. ##

About the Author

C. D. Hull attended State Normal College, Springfield, Mo., and joined Continental Oil Co. in 1920 as a pumper helper at the Ponca City, Okla., refinery. Through successive promotions there, he became assistant to the refinery superintendent in 1928 and assistant to the manufacturing manager the same year. Promoted to superintendent of the Ponca City refinery in 1949, he was named refinery manager in 1952.

Computers Cut Record Keeping Costs

Refiners recently have discovered that using computers to solve maintenance calculations and keep records will result in large savings

J. R. DeSilva and W. S. Pickrell
International Business Machines Corporation, Houston

REFINERS TODAY are saving hundreds of thousands of dollars by mechanizing their maintenance record keeping and technical calculations. The largest savings have been in more up-to-date reporting, better utilization of equipment and men, in lower operating costs and in improved products.

With the advent of the high-speed digital computer, the refiners were able to increase the number and size of the accounting and engineering applications they had mechanized. Probably more important, they were now able to undertake problems heretofore thought impossible. They are now able to work toward optimizing the refinery operation based on sales demands and prices. Problems of this nature will mean hundreds of thousands of dollars in the refiners' pockets.

Computers In Maintenance. There is another area of computation just now receiving a great deal of attention from refinery management. This is the use of high-speed digital computers and electronic data processing machines for the mechanization of maintenance records and calculations. A great deal of benefit will be received by using the computers for both the technical computations and the accounting or record keeping problems in refinery maintenance work.

Heat Exchanger Maintenance. A number of refiners realize that a heat exchanger program on a large scale digital computer can be an aid to them in their maintenance program. To point out this help, one refiner studied only the exchangers on one of the major units in his refinery.

The exchangers were on a six to eight months cleaning cycle. However, with the use of the exchanger evaluation program, the refiner showed that reducing the cleaning cycle to three months would result in approximately $40,000 a year savings over and above the increased maintenance costs. These savings are real and can be found for a number of exchangers in a refinery.

Most of the operating engineers associated with their particular units know from observation of the normal operating data that the cleaning cycle of the exchangers should be changed, upward or downward. What the computer program does for them is to give them substantiated cost and performance figures with which to sell management on a changed maintenance program, effecting a large savings to the refiner.

A typical heat exchanger program is mathematically similar to the standard hand calculation method used in the petroleum industry.[1] Physical properties of the flowing materials are obtained from laboratory analyses and from standard references. A heat and/or material balance is calculated, depending on the information available. The actual or assumed configuration of the exchanger is used to determine correction factors for the heat transfer equations. The program requires an average of sixteen seconds to evaluate each heat exchanger.

Record-Keeping Maintenance Applications. One application which refiners are using in the record keeping area on all types of electronic equipment . . . from punch-card systems up to the large scale magnetic tape systems . . . is the keeping and reporting of refinery equipment inspection records. We won't go into the details of the procedures as most of the companies have mechanized their own inspection department's system. However, they do tailor the system to fit the particular set of equipment they are using.

Advantages. One refiner having its inspection records mechanized on a punched card system reports the following four advantages:

1. Former method, manual hand posting to a spread sheet, very inefficient.
2. Metal Inspection Department claims punched card method saves them about 170 hours monthly; 160 of these hours formerly required the time of an engineer. Tabulating time monthly is about four hours.
3. Elimination of the guess work in scheduling equipment inspection and maintenance. A better safety feature.
4. Indicates to operating foremen the inspection schedule for the coming two months. This enables operating and inspection departments to work out mutually convenient schedules.

Another refiner using a large scale digital computer for inspection records of the tubing in furnaces reports savings of approximately three man months a year of an engineer's time. Another advantage, although one on which dollars cannot be placed, is that the engineer is re-

lieved of tedious hand calculations.

Unquestionably, one of the largest single items of controllable expense in a refinery or chemical plant is the cost of maintenance, both material and labor. One very important consideration in the control of these expenses is in the determination of what maintenance work should be done. Facts concerning this phase of the control of maintenance costs are occupying, and will continue to occupy, a considerable portion of management's time and talent.

Such basic considerations as to the necessity of incurring a given amount of maintenance cost now or delaying incurring these costs without hampering current operations, violating safety practices, or preventing expensive emergencies caused by future operating failure must be the prime concerns in any attempt to control the cost of maintenance. Without these, no system, regardless of how elaborate it may be, can be an effective tool for management's use in keeping a sharp lookout over these "controllable" items.

Example: A new maintenance work order giving plant, location of work, equipment number, ready date, completion date, order number, priority, estimated labor hours by craft, estimated material cost, etc., is converted to punched cards. These mobile records represent a complete backlog of estimated maintenance cost to be incurred. As daily labor hours and material issues are received, cards are also punched for these items.

Result: Machines can arrange these records and list up-to-date reports of active data at rates of thousands of transactions per hour. Machines that match like data can check to be sure charges for labor and material are being made to the right order and detect errors in reporting for immediate attention and correction. Further machine processing can provide daily figures or backlog hours for each job in progress and then summarize this data to show over-all manpower requirements for each craft for all work to be undertaken.

All data pertaining to a given work order, when completed, are then available for immediate use to prepare a permanent record of the work done, its costs as compared to the estimate, and its complete detail, even to detailed material part or requisition number used on the job.

But this is only half the story. The same card records which were used to charge the labor to the job can be used as the source data to prepare the worker's pay check. In addition, numerous reports, relating to attendance, overtime, rating, etc., are all made readily available as a result of creating the basic source record in machine processible form.

Detailed labor requirements data in this easily and quickly usable form makes possible more accurate forecasting of manpower requirements, pinpoints critical crafts, manpower deficiencies, upgrades requirements, manpower available and manpower not available because of sickness, vacations, etc.

In addition, the material charge card created to update material cost records can form the basis for mechanized inventory control. A great deal has been accomplished in recent years, using these record-keeping tools in the development of more scientific management of inventory. Machines have helped to make possible managing large inventories on a nearly complete exception basis.

This has been hastened more particularly with the advent of electronic data processing, employing the high-speed magnetic tape. This equipment can review an item in stock, price an issue and extend its value, reduce the balance, check minimum and maximum stock, recognize a receipt of goods, compute a new average price, keep track of historical usage figures, compute available days stock, compare lead time, check economical order quantity, and place the order all in a fraction of a second per item of inventory. They can keep track of advance requirements of material and signal to place the order early enough to get the job done, but not so early as to require expensive storage for long periods.

The most significant value of data processing machines . . . both electronic and punched card . . . to the control of maintenance costs is in these areas, and their extension. Once the rules under which these costs are going to be controlled and analyzed are established, they can be given to machines to carry out. The machines . . . in particular, the electronic computer . . . can then execute thousands of these rules or instructions in seconds, and give to management in detail or in summary the most timely information for action.

LITERATURE CITED

• Moore, R. K.; Carr, D. W., "Heat Exchanger Calculations on the IBM 650," IBM Refinery Computer Package.

About the Authors

DeSilva Pickrell

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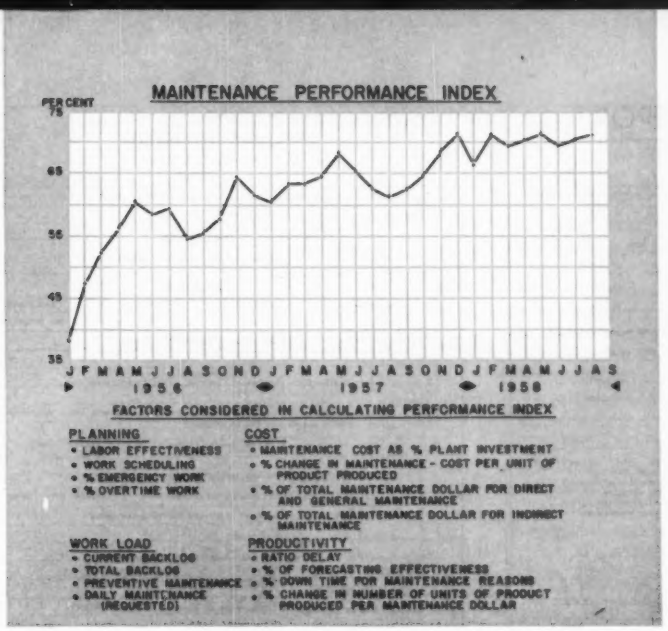
MAINTENANCE PERFORMANCE INDEX
PER CENT
75
65
55
45
35
J F M A M J J A S O N D J F M A M J J A S O N D J F M A M J J A S
1956
1957
1958
FACTORS CONSIDERED IN CALCULATING PERFORMANCE INDEX
PLANNING
• LABOR EFFECTIVENESS
• WORK SCHEDULING
• % EMERGENCY WORK
• % OVERTIME WORK
COST
• MAINTENANCE COST AS % PLANT INVESTMENT
• % CHANGE IN MAINTENANCE - COST PER UNIT OF PRODUCT PRODUCED
• % OF TOTAL MAINTENANCE DOLLAR FOR DIRECT AND GENERAL MAINTENANCE
• % OF TOTAL MAINTENANCE DOLLAR FOR INDIRECT MAINTENANCE
WORK LOAD
• CURRENT BACKLOG
• TOTAL BACKLOG
• PREVENTIVE MAINTENANCE
• DAILY MAINTENANCE (REQUESTED)
PRODUCTIVITY
• RATIO DELAY
• % OF FORECASTING EFFECTIVENESS
• % DOWN TIME FOR MAINTENANCE REASONS
• % CHANGE IN NUMBER OF UNITS OF PRODUCT PRODUCED PER MAINTENANCE DOLLAR

FIGURE 1—Performance index shows a material maintenance cost reduction in the last three years.

Planning-Scheduling Cut Plant Costs

Performance index shows that Chemstrand has reduced maintenance costs in three years. Planning and scheduling are cited as the major cost reduction factors

Paul Taylor
The Chemstrand Corporation, Decatur, Ala.

EARLY IN 1956, the maintenance personnel of Chemstrand's acrylic fiber plant accelerated efforts toward improving maintenance performance. Increased attention was paid to work planning and scheduling techniques and a planning and scheduling group was established within the plant engineering department.

One function of this group is the compilation of performance data for the plant engineering department. As a check on three years performance, Chemstrand adopted the use of a maintenance performance index developed by W. S. Luck with Du Pont. This index is based on the measurement and combination of 16 factors which are included in the general groupings of planning, cost, work load and productivity. The maintenance performance index chart (Figure 1) highlights how maintenance performance has been improved at Chemstrand during the past three years. Work planning and scheduling has been cited as the significant role in this development.

Planning. We believe that work planning is never wasted, even though the job may not be actually carried out as originally planned. In other words, the work planning which was done in this case helps us to arrive at an alternate plan more quickly.

All of our capital addition jobs and all of our major maintenance expense jobs are provided with a complete bill of material, a detailed description of the work to be carried out as the job proceeds and a safety check list, all of which are prepared by a project engineer.

The work order cover sheet (Figure 2) briefly describes the over-all job. The detailed description of work (Figure 3) includes the order in which the job should proceed: that is, which part of the job is to be tackled first and the next step to make, etc. It also indicates the different types of skills that will be required in order to carry out the job. In some instances, it may show how

SPECIAL MAINTENANCE REPORT

PLANT ENGR. FORM NO. 4.0

PLANT ENGINEERING WORK ORDER

DECATUR PLANT

PROJECT NO. 1168 — WORK ORDER NO. 1-1752

ESTIMATE NO. P.E. 822 — GE. NO.

REF. DWGS. E1-255, E1-258, D-797, D-803; E1-257, E1-256, D-796, D-802

DEPARTMENT NO. 112 — DATE ISSUED 6/7/58

REQUESTED BY C. S. Roark — PROCESS ☒ NON-PROCESS ☐

AREA ENGINEER Hal Brazelton

JOB TITLE Increase Steam Pressure To Polymer Dryer

DESCRIPTION OF WORK

Install additional pressure reducing station on the 275 psig steam line at Polymer. The reducing station will supply steam at 150 psig to the Procter & Swartz Dryer. Install and insulate a 4" pipe line from the reducing to the existing 6" steam header over the dryer. A 6" line is also to be installed parallel to the 6" header to supply 70 psig to equipment supplied by the 6" 70 psig header at present.

ESTIMATED COST:

EQUIPMENT & MATERIAL	3700	OUTSIDE CONTRACT	
LABOR	2500	CONTINGENCY & OVERHEAD	600
		TOTAL	6800

APPROVALS:

PLANT ENGINEER Paul Taylor

PLANT MANAGER See Approved PAR

FIGURE 2—Work order cover sheet describes scope of job.

ENGR. FORM NO. 4.1

WORK ORDER

DETAIL DESCRIPTION OF WORK

DECATUR PLANT

WORK ORDER NO.	PROJECT NO.	DEPARTMENT	AREA ENGINEER
1-1752	1168	112	Hal Brazelton

DETAILED DESCRIPTION OF WORK

A Safety Check of the Area should be made prior to starting work.

1. Isolate 275 psig steam line by closing and locking main valve at Northeast corner of Main Street and Fourth Avenue.
2. Make tie-in on main steam line up stream of existing pressure reducing station.
3. Install pressure reducing station and by-pass line.
4. Install 4" pipe from reducing station to existing 6" header over dryer.
5. Tie into 6" header with 4" line from reducing station.
6. Cap off west end of 6" header.
7. Tie in 4" 70 psig line into existing 70 psig steam line.
8. Extend 4" 70 psig line parallel to 6" steam header and tie into existing 70 psig equipment.
9. Change orifices in steam traps in dryer to 150 psig capacity.
10. Insulate all new piping.
11. Clean up area.

NOTE: If it is necessary to use the 275# steam line, be sure to install a blind or lock out a valve in the new line until work is complete.

PAGE 2 OF 5 PAGES

FIGURE 3—Description gives order of work performance.

ENGR. FORM NO. 4.1

WORK ORDER

BILL OF MATERIAL

DECATUR PLANT

WORK ORDER NO.	PROJECT NO.	DEPARTMENT	AREA ENGINEER
1-1752	1168	112	Hal Brazelton

SOURCE	MATERIAL	QUAN.	UNIT	UNIT COST	P&R	AMOUNT
16-48,102	4" x 4" x 4" Tee, sch. 40, forged seamless steel, welding	3	only			
21-12,397P	4" 90° ell, sch. 40, forged seamless steel, welding	9	only			
16-45,243	4" x 2" Reducer, sch. 40, welding forged seamless steel	2	only			
16-4888	2" x 2" x 2" Tee, sch. 40, welding forged seamless steel	2	only			
16-53,124	2" weld neck flange, series 300# forged seamless steel	2	only			
16-53,122	2" weld neck flange, series 150# forged seamless steel	2	only			
16-46,196	2" 90° ell, sch. 40, forged seamless steel	2	only			
16-53,159	4" weld neck flanges, series 150# forged seamless steel	2	only			
21-12,397P	6" x 4" reducer, sch. 40, forged seamless steel	2	only			
21-12,397	6" pipe cap, sch. 40, forged seamless steel	1	only			
15-80,180	4" pipe, sch. 40, grade A-106 seamless steel	175	ft.			
15-80,150	2" pipe, sch. 40, grade A-106, seamless steel	10	ft.			
Salvage - Valves returned from Turner Mfg. Co.	2" - 150# gate valve, cast steel, Powell fig 1503 or equal, flanged.	3	only			
21-12,709P	6" I ps kaylo pipe insulation 1½" thick	200	ft.			

PAGE 3 OF 5 PAGES

FIGURE 4—The project engineer fills out this bill and requisitions the material.

PLANT ENGINEERING FORM NO. 5

SAFETY CHECK LIST

WORK ORDER NO.	PROJECT NO.	DEPARTMENT	AREA ENGINEER
1-1752	1168	112	Hal Brazelton

1. ☑ Check in with department supervision to be sure job is ready to be worked on.
2. ☑ Isolation — ☐ (a) SWITCHES: Fuses out? Warning tag signed by you?
   ☑ (b) PIPING: Valves, cocks closed and tagged? Need stopper plates? Lines empty? Should control valves be locked?
   ☐ (c) TANKS: Any chance of steam, hot water, chemicals, etc., getting in? Need stopper plates? Ventilation?
3. ☑ Need warning devices: signs, barricades, lights, etc.?
4. ☑ Need a check for flammable gases?
5. ☑ Need a field check for hidden cables, piping, etc.? Shields for protection against hot electrical equipment?
6. ☑ Have you protected against equipment, personnel damage or injury from falling objects, sparks, flame, etc.?
7. ☑ Have you proper protective equipment: Goggles, hard hats, life belts, respirators, etc.?
8. ☑ Have you proper equipment to do the job safely?
   ☑ (a) Scaffolding, tools (need spark proof?)
   ☐ (b) Need shoring, bracing, etc.?
   ☐ (c) Need more light?
   ☑ (d) Ventilation?
9. ☑ Have you planned a safe way to do the job? Have you set up booby traps, tripping hazards with hoses, cables, cords, open manholes, pipes, etc.?
10. ☑ Remember: The job is not completed until: ALL GUARDS ARE BACK IN PLACE!! Excess material and scrap picked up, scaffolding, rigging removed. Are you leaving any holes in the floor?

FIGURE 5—Safety check list clearly shows safety procedures to be used.

On minor maintenance jobs, a bill of material is prepared by an engineer, but the job is planned and handled completely by the maintenance foreman

PREVENTIVE MAINTENANCE SCHEDULE

PROPERTY NUMBER MCH. NO. - MOTOR NO.		ITEM NO.	SOV. RECOVERY	JAN.	FEB.	MAR.
33-80		2615	Flash Still Condenser (6 Months)			
33-81		2606	High Pressure Vaporizer (6 Months)			
33-82		2606	High Pressure Vaporizer (6 Months)			
33-83		2614	Flash Still Calandria (During Shutdown)			
33-84		2607	Low Pressure Vaporizer (During Shutdown)			
42-139	39-701	2656	Water Booster Pump		C	
42-140	39-702	2636	Condensate Pump		C	
42-141	39-703	2636	Condensate Pump		C	
42-142	39-704	2627	Vaporizer Circulating Pump	C		
42-143	39-705	2627	Vaporizer Circulating Pump	C		
42-144	39-706	2638	Drain Tank Pump	A		
42-145	39-710	2627	Circulating Pumps - Heaters	C		
42-146	39-709	2629	Circulating Pumps - Heaters		C	
42-147	39-708	2629	Circulating Pumps - Heaters			C
42-148	39-707	2627	Circulating Pumps - Heaters	A		
42-149	39-712	2631	Column Reflux Pump Third Effect		A	
42-150	39-711	2631	Column Reflux Pump Third Effect		A	
42-151	39-713	2630	Second Effect Column Reflux Pump			A
42-152	39-714	2630	Second Effect Column Reflux Pump			A
42-153	39-715	2628	First Effect Column Reflux Pump			C
42-154	39-716	2628	First Effect Column Reflux Pump			C
42-155	39-718	2625	Solvent Feed Pump	C		
42-156	39-717	2625	Solvent Feed Pump	C		
42-157	39-720	2626	Solvent Feed Pump		C	
42-158	39-719	2626	Solvent Feed Pump		C	

FIGURE 6—Master preventive maintenance schedule is made for one year, in advance.

BAR-13

PREVENTIVE MAINTENANCE SCHEDULE

DEPT. Polymer MONTH OF January 19 59

ITEM		1-	10	4-	8-	15	0-	1-	0B	6-	0T	11	22
Reactor Aglt. & Motor (309-015)	3-111 C-327					A							
Monomer Feed Cooler	3-112						A						
Catalyst Feed Cooler	3-113						A						
Catalyst Feed Heater	3-114						A						
Water Feed Cooler	3-115						A						
Water Feed Heater	3-116						A						
B- Chilled Water Circ. Pump & Motor	3-117 D-328							A					
Reactor Hold Tank Aglt. & Motor	3-118 C-329							A					
Reslurry Tank Aglt. & Motor	3-119 C-330								A				
Bottoms Pump (A)	3-121									C			
Bottoms Pump (B)	3-122									C			
Cont. Reactor Feed Pump (A)	3-123									C			
Cont. Reactor Feed Pump (B)	3-124												C
River Water Booster Pump (A)	3-125												C
River Water Booster Pump (B)	3-126												C
Polymer Mill (Delivery End)	3-127												
Polymer Mill Drive Mechanism	3-128												
Polymer Dryer	3-129												

A-Indicates Complete Overhaul
C-Indicates Preventive Maintenance Check

Approved: _____
Approved: _____
Approved: _____

FIGURE 7—The planning and scheduling group prepares this monthly preventive maintenance schedule.

scheduling of equipment downtime must be coordinated with manufacturing operations. The engineer prepares a complete bill of material for the job (Figure 4) and requisitions all the material either through stores or by purchase order. The safety check list (Figure 5) indicates the safety procedures and/or safety equipment which must be used in carrying out the job. All of this work planning is done by the engineer before the work order and drawings are issued to the field.

On minor maintenance jobs, such as alterations and small development jobs or any other jobs which are not classed as actual maintenance or repair, a bill of material (Figure 4) is prepared by an engineer. Also, on this type of job, a small, lettersized sketch is required. Minor maintenance and repair jobs are handled completely by maintenance foremen. They do all of the work planning and material procurement as well as the work execution.

Material and equipment for all these jobs, that is for capital addition, major maintenance expense jobs and minor maintenance jobs, except maintenance and repairs, are stored and accumulated in work order bins until all of the necessary material and equipment is on hand and can be scheduled for work execution. On capital projects and major maintenance expense projects, receiving records are accumulated by the project engineer prior to scheduling. On the minor maintenance expense jobs which are scheduled,

MAINTENANCE DEPARTMENT PRIORITY SCHEDULE

FOREMAN: Frank Burns WEEK OF 9-2 THRU 9-5

W.O. NO.	JOB DESCRIPTION	ENGINEER	MON	TUE	WED	THU	FRI	ENGR. - HOURS
	Ship Welding			2	1	2	2	
7-0007	S hook			1			1	4 Day
6-0901	Weld crimper rolls	Keil		1	1	1	1	
1-1704	Dope system			4	4	4	4	
1-1596	Install eye washes south wall 2nd floor of Dope Prep.				2			
1-1589	Relocate sampling taps for CR solvent control	Gundle h						
6-1066	Tie in condensate drain to system	Keil				2		
4-0077	Divert water cooling to air compressor in Ref.					2	2	
6-0802	Humidify water heater				2			
4-0043	Make Filters Hydrostal	Sanford		1				M.O. 304-10981
4-0025	Sprinkler heaters	Du bell						

NOTES:

FOREMAN: Burns

CREW MAN TOTAL

MECHANICS 11

HELPERS

TOTAL 11

FIGURE 8—A weekly job schedule is made each Thursday.

FOREMAN'S DAILY WORK PLAN

FOREMAN W. MITCHELL

DATE

MATERIAL AVAILABLE: YES = MATERIAL ORDERED AND WILL BE HERE BY TOMORROW; NO = MATERIAL WILL NOT BE HERE BY TOMORROW

DESCRIPTION	DEPT.	W.O. NO.	MATERIAL AVAILABLE	END	Bowles	Buckley	Cobb	Hodges	Miller	Crew	Reed	Robbins	Terry	Sp.
									1					

material and equipment receiving records are accumulated by planning and scheduling personnel. Before any job is scheduled, a physical check of all material and equipment shown on the bill of material is carried out by planning and scheduling personnel.

Scheduling. Work scheduling is a function of planning and scheduling personnel and of the maintenance foremen. The planning and scheduling group provides the coordination between different skills necessary to schedule jobs that require the joint effort of different groups such as electrical, instrument, sheet metal, etc.

The planning and scheduling group prepares general work schedules that show the number of men required, dates and general work requirements. These general schedules are then used by maintenance foremen to prepare specific work schedules which show job assignments for each of his men.

Preventive Maintenance. The planning and scheduling group handles two general types of scheduling—preventive maintenance sched-

Conference Panel Answers Maintenance Questions

THE PAPER you have just read was presented to the Plant Maintenance and Engineering Conference, Cleveland, January 26-29, 1959. Paul Taylor, maintenance superintendent, The Chemstrand Corporation, Decatur, Ala., was the speaker and Jodie Isenhower, head of maintenance coordination, Humble Oil & Refining Company, Baytown, Texas, was the session chairman.

During the discussion period following Taylor's talk, PETROLEUM REFINER's maintenance editor made the following notes which will give you a further insight into modern process plant maintenance.

Maintenance Index. This index, modified at Chemstrand, was originally developed by W. S. Luck with Du Pont. The factors to be considered in using the index are shown on Figure 1. One item with which you may not be familiar is the ratio of delay. This ratio is simply the total work performed divided by the total work *less* the amount of nonproductive work, Taylor said.

Emergency Jobs. Emergency maintenance work at Chemstrand amounts to approximately 5-15 percent of the total maintenance work performed.

Isenhower reported that Humble uses an emergency job classification (E) for work where a real and immediate serious hazard exists or where a large amount of money is actually being lost through failure to produce product quality or quantity. When a foreman puts an E priority on a job, the work is started immediately; however, to prevent indiscriminate use of this classification by foremen to get their pet jobs done fast, each E job is carefully reviewed by the foreman's boss. The result of such critical review is to confine emergency work to only those unavoidable jobs that can't be put off.

Work Orders. Of the several work order classifications at Chemstrand, number 4 is a maintenance expense item which is a modification or alteration of plant equipment but does not increase the capital investment. Order number 5 is for experimental work, number 6 is preventive maintenance on instruments and number 7 is an order on minor new equipment installation that does not amount to enough for capitalization. Area engineers plan 4, 5 and 7 class work orders and maintaince work with the operators.

An excess number of work requests can cost a great deal of money and reduce the maintenance department's efficiency. Humble checks each work order to determine if the work is actually needed and if the work request covers the optimum way to accomplish the desired objective. This results in the elimination of unnecessary work requests and therefore cuts costs.

Chemstrand also uses a formal work request system for larger jobs that require engineering. The formal work requests are screened and approved by management to eliminate unnecessary work.

Estimating. Chemstrand does not use standard time data for estimating the time required to complete jobs requested on work orders. Humble does use standard time on certain jobs like welding tank bottoms, pipe welding, etc. But, Isenhower thought that it was more important to coordinate the work of craftsmen on several jobs than it was to know that it takes 1.2 hours to unhead an exchanger. In other words, good supervision is very important, even from a time estimating standpoint.

The trouble with estimating by standard time is the almost intangible element of handling the work material. For example, Humble feels that in their shop of 40 welders, the men are working real hard if 11 arcs are going all of the time.

uling and job scheduling. A typical master preventive maintenance schedule for a portion of one of our process areas is shown on Figure 6. Schedules of this type have been prepared jointly by planning and scheduling personnel, area engineers, industrial engineering, maintenance foremen and area manufacturing supervision. This type of preventive maintenance includes routine inspections followed by minor repairs, as required, and routing complete overhauls of equipment. (Note that the master schedule on Figure 6 covers one year.) This schedule is not issued to foremen but rather is used by planning and scheduling personnel to prepare a monthly schedule (Figure 7). The monthly schedule is prepared jointly with manufacturing supervision so that equipment downtime for preventive maintenance can be coordinated with production schedules. This type of preventive maintenance schedule is then issued to the appropriate maintenance foremen on a monthly basis.

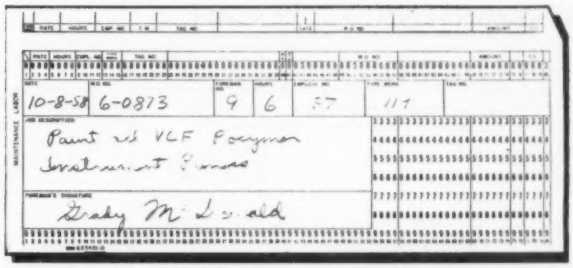

FIGURE 10—Each mechanic receives a daily punch card which lists the jobs and a brief description of the work he is scheduled to do the following day.

Spare Parts. Taylor reported that spare parts in their plant amounted to ¾ of 1 percent of the total plant investment. Their total stores represents about 1½ percent of the total plant investment.

In a 1958 plant survey, Chemstrand found that 10 percent of the mechanic's time was spent in going after parts. So, they set up a "5 & 10 cent store" in the various departments for items costing $1 or less. Mechanics can get these small items quickly and the company has found that the idea has reduced walking time considerably.

Chemstrand reviews slow moving parts once a year and plans to use their electronic computer in an effort to determine the optimum stores that should be maintained.

Scheduling. Does the planning and scheduling department review work requests, like painting, that can be put off for a year? At Chemstrand, the planning and scheduling group holds a weekly meeting. At this meeting, all work requests are reviewed and the less important are scheduled at a later date. It was admitted, however, that because the planners are human, sometimes the operator who yells the loudest for a work request gets his job done first.

Isenhower said that operators are not mechanical people and often-times request jobs that cost too much or are not as urgent as the classifications they request. Therefore, Humble's maintenance and construction division reviews all requests and refers some of them back to the originator for review to see if the job is justifiable or if the priority can be changed to permit deferring the work to a later date.

Taylor said that one side result from their planning and scheduling program was a reduction in paper work required of the foreman; because, before the program was started, the foreman did all of their own planning and scheduling.

Minor Reports. Like most plants, the major part of Chemstrand's maintenance work is performing minor repairs. Approximately 80 percent of their maintenance workload is done in minor repair work.

Backlog. Chemstrand maintains a current backlog of about 2-4 weeks work, which is felt to be about the optimum amount. The reason they feel that this is optimum is that many of these jobs are waiting for engineering work or for materials that have been ordered. However, Taylor pointed out that Luck with Du Pont feels that a two-week backlog is optimum.

Lubrication schedules for the entire plant have been issued and are in use. These preventive maintenance master schedules are subject to periodic reviews by maintenance foremen, area engineers, area manufacturing supervisors and industrial engineers and are revised as required to provide the optimum amount of preventive maintenance.

Weekly Schedules. On Thursday of each week, the planning and scheduling group prepares a weekly work schedule for the following week. Requests for jobs to be scheduled are forwarded to the planning and scheduling supervisor from area engineers, project engineers, maintenance foremen and in some instances, manufacturing supervisors. All available maintenance manpower, except that already scheduled for preventive maintenance, is used in the preparation of this weekly job schedule. A typical schedule of this type is shown on Figure 8.

Remember that the planning and scheduling group makes a physical check of all work order materials prior to scheduling to insure that all

SPINNING MACHINE OVERALL SCHEDULE & CHECK LIST

TURN IN TO MAINTENANCE GENERAL FOREMAN IN CHG. AREA WHEN COMPLETE

DATE: _____

STARTING TIME	DESCRIPTION	FOREMAN	MEN	CHECK WHEN JOB COMPLETE
7:00	Disconnect all electric Motors Starting at west end. Check Turn Table Motor. Clean, Check All Hood & Aisle Lights. Check All Electric Circuits.	Dodd	2	_____
	WHEN OIL GEAR EQUIPT. IS INSTALLED: Hook up all motors when notified by Job co-ordinator. Check & O.K. Job. _____	Foreman		_____
	FIRST DAY			
7:00	Remove Tachometer Oil Gear & Motors. Remove Other Oil Gear Equipt. Bring to shop and transfer couplings, & Fittings.	Harper	4	_____
	SECOND DAY			
	Replace Oil Gear Equipt. Check & O.K. Job. _____	Foreman		_____
	FIRST DAY			
7:00	Remove Johnson Joints.	Burns	3	_____
8:00	Take Down Oil Gear Lines When Notified that rolls are in (3)men to replace Johnson Joints. When notified that oil gear equipment is in, send (2) men to replace Oil Gear Lines. (Refill with Oil by Slaten's man) Check & O.K. Job. _____	Foreman	5	_____
	FIRST DAY			
7:00	Check Turn Table.	Slaten	2	_____
7:00	Replace Pumps.		1	_____
7:00	Clean Soft Finish Filter & Change Soft Finish Pump & Drive.		2	
7:00	Drain Oil From Oil Gear.		1	_____
9:00	Remove Rolls, (Notify G. McDonald to Paint Front). Check Idlers, Clean Machine.			_____
	SUCCEEDING DAY OR DAYS			
	Finish Idler & Replace Rolls. Notify McDonald to Paint Roll ends and back of machine when rolls are in. When Painting is Finished Notify F. Burns to Replace Joints. Reinsulate Piping - Notify McDonald to Paint Piping.		5	_____
	Check Over & Start Machine Check, Correct & O.K. Job. _____	Foreman		_____

FIGURE 11—Special check lists help carry out routine preventive maintenance and overhauls.

WORK SCHEDULE FOR WORK ORDERS

PLANT ENGINEERING DEPARTMENT — DECATUR

WEEK OF 9-29-58

MASTER PRIORITY LIST

W/O No.	DESCRIPTION	DEPT.	STATUS	AREA ENGR.	PRIOR.
1-1777	Tow Sampling Hopper	106	40% - in progress 10-3	Hill	1
5-0065	Experimental Baler Duct	106	40% - in progress 10-10	McCrory	2
1-1704	Blending Dope with Production	103	95% - in progress 10-1	Hill	3
6-0869	#3 Boiler Maintenance	151	40% - in progress 10-10	Gossett	4
6-0933	Repair Lindberg Furnace	104	In progress 9-25	Armentrout	5
1-1760	U.N. Bldg. Heating Modification	270	Scheduled 10-10	Hill	6
6-0926	Fabricate 100 Tow Cans	104	85% - in progress 10-1	Kilpatrick	7
6-0976		101			
6-0963	Painting in Solvent and Solvent Recovery	105	95% - in progress 9-22	Phillips	8
4-0045	Fabricate Welding Receptacles	103	95% - in progress 10-1	Dunlap	9
	INSTRUMENT SECTION				
4-1704	Install Dope Recycle Instruments	103	90% - in progress	McKelvey	1
6-1200	Flow Meter Calibration	113	50% - in progress	Richards	2
4-0035	Air Control to Filters	112	Scheduled	Richards	3
1-0887	Clean & Calibrate #3 Boiler Instruments	151	Scheduled	Browning	4
4-0031B	Modify EVF Level Indicator	102	Scheduled	Richards	5
4-0039	Install Inert Gas Pressure Recorder	155	Scheduled	Browning	6
4-0033B	Modify Vaporizer Level Transmitter	105	Scheduled	McKelvey	7

APPROVED BY: _____ 9/26/58 Plant Engineer _____ Manufacturing Manager

FIGURE 12—Weekly master priority list helps in scheduling emergency jobs.

necessary materials are available. Once the job is scheduled, all work orders or minor orders, drawings, sketches and bills of materials are given to the appropriate foreman along with his schedule.

About the Author

Paul Taylor is maintenance superintendent for The Chemstrand Corp., Decatur, Ala. Previously an instrument engineer with E. I. du Pont de Nemours & Co., Inc., he has worked in the same capacity for Union Bag—Camp Paper Corp. He received a B.S. degree in chemical engineering from Georgia Institute of Technology in 1949. Taylor is a registered professional engineer in Alabama and a member of the ISA.

Daily Schedules. Whereas the planning and scheduling group prepares broad general schedules, the maintenance foremen use these schedules as a guide to prepare detailed specific schedules. Every afternoon, each maintenance foreman prepares a schedule for the following day's work. This is the schedule where specific individual mechanics are assigned to the jobs which have been assigned to the particular foreman. A typical foreman's schedule is shown on Figure 9. From this schedule, the foreman prepares mechanic's daily work cards which are issued to each mechanic and which lists the jobs and brief description of the work he is scheduled to do the following day. One of the punch cards used for this purpose is shown on Figure 10.

Various maintenance foremen, along with planning and scheduling personnel, have prepared special check lists to aid in carrying out routine preventive maintenance checks and overhauls. An example of this special type of check list is shown on Figure 11.

Emergency Work. It is of course recognized that emergencies and demand maintenance will preclude carrying out 100 percent of the scheduled work. In fact, each morning at 7:45 a.m., the maintenance superintendent, maintenance supervisor, maintenance general foremen, area engineers and the planning and scheduling supervisor meet for about 10 to 20 minutes to review any emergency jobs which have developed overnight and to assign priorities to crash jobs.

Recognizing the fact that some scheduled work must be dropped to handle emergency work, each Friday the planning and scheduling group prepares a weekly master priority list which shows the priority of certain jobs scheduled for the following week. An example of this list is shown on Figure 12. This list, which is reviewed and approved by the plant engineer and manufacturing manager, is then used as a guide to maintenance supervision in selecting the jobs to be dropped from the schedule in order to handle demand maintenance work. ##

Spring Solves Soft Packing Problem

Packing life can be extended greatly, maintenance costs cut and downtime for packing failures practically eliminated by adopting these ideas

Walter Coopey
Engineering Consultant, Charleston, W. Va.

SOFT PACKING applications have taken a long step forward through the use of a spring in the stuffing box. Packing life can be extended from a few hours to months. The key is lubrication applied to points of highest packing pressure and temperature.

In the 3rd edition of Van Nostrand's Scientific Encyclopedia, January, 1958 it is stated:

"A stuffing box is a recess in the wall surrounding the point of exit of the shaft, arranged to receive a soft and pliant packing such as treated hemp, or leather, which is compressed in the box and pressed firmly against the shaft by the pressure exerted against it from a gland. The gland is tightened against the packing by screw threads until the leakage is reduced to negligible amount but not enough to produce seizure or excessive frictional heating of the shaft. Stuffing boxes are used primarily to seal against leakage around small shafts."

Of course, other and better materials than hemp and leather are now being used but, in general, the way in which soft packings are installed has not been changed in at least the last 50 years. Some of the special designs and forms of packings being offered as improvements are illustrated in reference books that were published in 1908. In spite of better materials both for packings and for shafts, the life of a packing installation, if the service is at all severe, may sometimes be only a matter of a few hours.

By the conventional arrangement

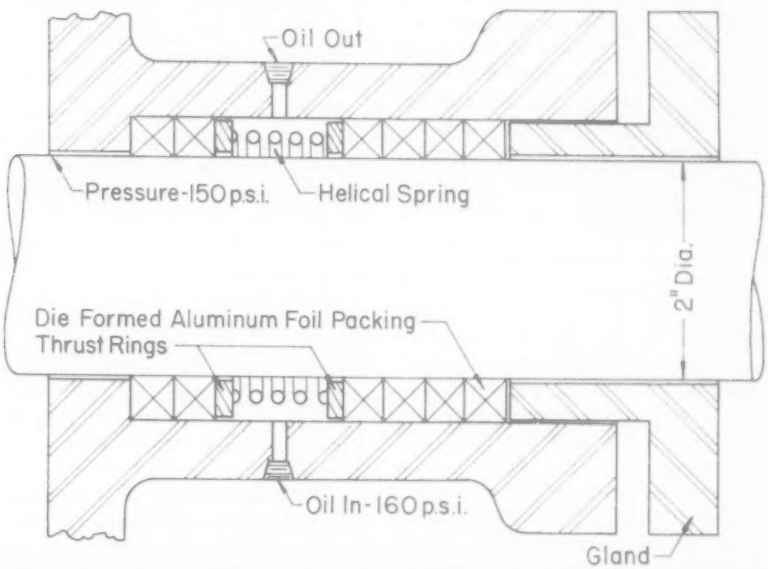

FIGURE 1—A spring instead of a lantern ring is the main difference between this and the conventional packing arrangement.

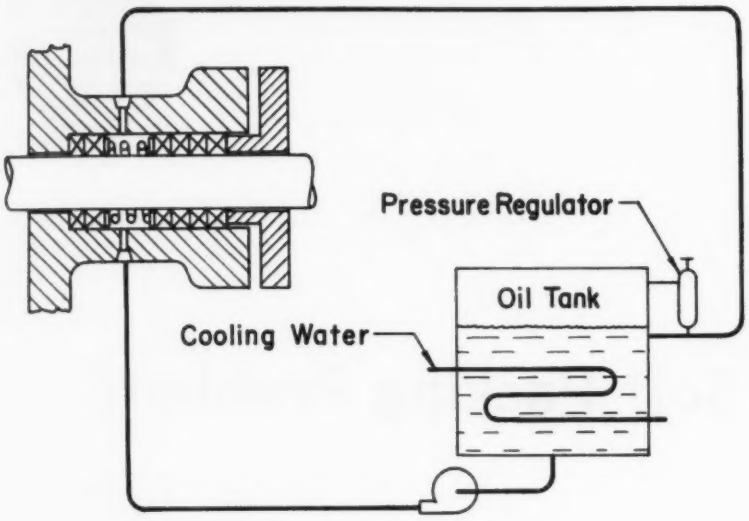

FIGURE 2—An oil circulating system provides some cooling effect.

is meant one in which there are two sections of packing separated by a rigid lantern ring into which a lubricant is introduced[1]. There are many factors that can contribute to packing failure and most of these are recognized but invariably, except for minor variations, the stuffing box arrangement has always been the same. Special forms of packing, better lubricants, improved packing materials with built-in lubrication can alleviate conditions to a relatively minor degree but do not correct them. The real problem is to get the lubricant to the region of highest friction where it will do the most good and which can not be done with the conventional stuffing box arrangement.

A packing application, taken at random, will be described which had conditions of service that were rather severe. This was a case where a pump was required to handle a noncorrosive fluid at 150 psi and 650 F and which contained 10 percent abrasives. The shaft was 2-inch dia. and the speed was 3600 RPM. Even though many kinds and makes of packings were tried, the abrasives would quickly get into the stuffing box and ruin both the packing and the shaft. In the conventional stuffing box, the lubricant must either go into the pump or vessel or out through the gland. When the latter happens there is nothing to prevent the fluid being handled from entering the stuffing box. The result is failure.

In Figure 1, the design does not appear to be much different than it would be for the conventional arrangement. The chief difference is the substitution of a spring for a lantern ring but this apparently minor change introduces a new concept in how a packing functions. Instead of the point of highest friction being at the outer end of the stuffing box and furthest away from the source of lubrication, as in conventional arrangements, it is now at the inner end of the outer section of packing next to the spring and directly exposed to the lubricant.

The pressure exerted by the gland in the conventional arrangement is an unknown quantity depending upon the individual who adjusts the gland for packing take-up. Normally, the outer rings of packing are the most highly compressed but sometimes such excessive pressure can be developed by the gland that the packing will be jammed together and the oil hole plugged. The result is packing failure and possible scoring of the shaft. When the latter happens, packing life gets progressively shorter until the shaft is replaced. This is very often the rule rather than the exception. With my spring loaded packing, there can be no overcompression of the packing and lubrication is just where it is needed most.

The packing in Figure 1 consists of two inner rings and four outer rings separated by a compression, helical spring. Thrust rings are used at each end of the spring to evenly distribute the spring load to the packing and, because of the temperature, die formed rings of $\frac{3}{8}$" square aluminum foil packing were specified. These were tangentially cut so that they could be readily slipped over the shaft. Two rings are used at the inner end of the stuffing box since, with the oil supplied at 10 pounds above the 150 psi pump discharge pressure, this packing is only required to hold oil at this differential pressure. Therefore, no abrasion occurs in the stuffing box or corrosion when a corrosive fluid is handled. Four rings are used as the outer packing because this must hold the highest pressure. However, retaining oil is an easy service particularly as the point of highest friction is at the inner end in direct contact with the oil. With any soft packing, dependence must be placed upon boundary lubrication but with the die formed aluminum packing, which tends to become like a bearing, there is an approach to film lubrication.

Because the spring is immersed in oil, it was made of carbon steel and, as it is under practically constant load, there is no fatigue problem. The duty is relatively easy.

Under normal conditions the oil consumption should not be over 2 or 3 drops per minute but, because of the temperature (650 F), an oil circulating system, as shown in Figure 2, was used to provide some cooling effect. This may not have been necessary since the aluminum packing is supposed to be satisfactory for the temperature but the system was part of the original set up and it seemed advisable to retain it. This is a more effective way of cooling than with a water jacket which does a very indifferent job because any cooling effect must be transmitted to the shaft through a packing which is generally a fairly good insulating material. Oil circulating systems with pump, oil storage tank, cooler, pressure regulator, etc. are obtainable as package units. In this application the pressure regulator was set at 160 psi.

One important precaution that should be taken with any method of lubrication is to have it functioning before operating or process pressure is developed. The method of lubrication is adapted to the particular type of service and can consist of a lubricator, sight feed oiler, grease cup, etc. as may be required for high pressure, low pressure, varying pressure or vacuum.

In this operation, the packing, which had imposed a process limitation because its life might only be a few hours, became the most dependable part of the pump after the spring loaded packing arrangement was installed. The life increased from hours to months when overhauling of the pump became necessary because of internal erosion by the abrasives.

Since corrosion was not part of the problem, the shaft was made of a low alloy steel hardened to 50 Rockwell C and finished to 10 micro-inches. For very tough services, a finish of 5 micro-inches would be better. Other materials such as hardenable stainless steels can be used for corrosive action and, if it is not expedient to make the entire shaft of such materials, a sleeve can be used.

Because only the most difficult problems have come to the attention of the writer, no work has been done on relatively easy applications which might also be benefited by using the spring loaded principle. For example, Figure 3 shows how it might be applied for a clean fluid with some degree of lubricating properties. Under such conditions one set of packing with the spring exposed to the fluid would suffice. A chevron type packing is shown which should have some built-in lubrication such as there is in tetrafluroethylene resins and similar materials. Chevron rings are useful where there are space limitations and I have used them of various materials in such cases with the two set packing arrangement. In the single packing arrangement the spring should be made of a noncorrodible metal.

The operation of packing in a stuffing box may be considered roughly comparable to that which exists in an automobile engine. In the latter, if the specified oil level in the crank case is maintained, it is possible to travel a thousand miles on a pint of oil for long periods of time. However, if there is no oil, what is the result? Bearings, piston rings and cylinders can be ruined very quickly. In the same way, the packing and shaft can be ruined in the conventional stuffing box because oil can not get where it is needed unless there is leakage from the gland. On the other, with the spring loaded packing arrangement, oil leakage is not necessary and the points of friction are well lubricated. This may not be a good analogy but I am simply trying to point out that a little oil will go a long way if it gets between rubbing surfaces. Even under the most severe conditions the minimum packing life should be six months.

There is no question that the increased use of mechanical seals has been attributed to the generally poor performance of soft packings but in many cases even the mechanical seal is not the answer. About as many articles have been written on how to remedy mechanical seal troubles as there have been on soft packing problems. Each has its place, but for difficult application there is no comparison in the performance that can be obtained with soft packing in the conventional arrangement and in the spring loaded arrangement. It can make the difference between hours and months of operation or between failure and success if packing a rotating shaft is the critical factor as it sometimes can be. While there is nothing wrong about the purpose for which the conventional stuffing box was invented by Sir Samuel Morton many years ago, there is nothing right in its application and it should now be considered obsolete.

All of the applications of the spring loaded arrangement have been made on installed equipment such as pumps, autoclaves, reactors, mixers, filters, etc. where no other type nor make of packing gave satisfaction. Designs have been developed for shafts ½ inch to 7¾ inch diameter; for pressures from vacuum to 5000 psi; and for shaft speeds up to 3600 rpm. With many of these it was necessary to make compromises but, even so, satisfactory performance was obtained. In fact, there is no hesitancy in guaranteeing acceptable results.

Because conditions are rarely the same in widely different services, some know-how is a definite advantage in order to get the best installation. It is necessary to consider the chemical and physical properties of the fluid; the presence of abrasives; the speed and size of the shaft; the temperature of the fluid; etc. and be governed accordingly. Eventually, however, springs should entirely replace lantern rings in packing arrangements.

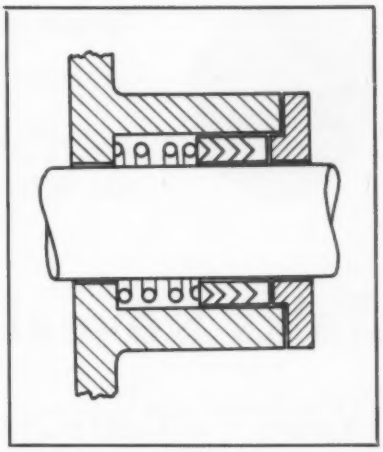

FIGURE 3—For clean fluids, use spring loaded chevron type packings.

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[1] Coopey, Walter, "How To Stop Packing Failures," PETROLEUM REFINER, Dec., 54, p233.

About the Author

Walter Coopey is a private consulting engineer in Charleston, W. Va. He previously had 33 years experience with E. I. duPont de Nemours & Co. There he served as a development engineer, and as an engineering manager and consultant. Beginning with work on ammonia synthesis in 1925, Coopey engaged in the development of a wide variety of processes based upon a high-pressure technique involving pressures up to 35,000 psi. He has been in private consulting work for the past eight years. He is a graduate of Pennsylvania State University with a B.S. degree in mechanical engineering.

Round table talks show maintenance practices in refineries vary as much as plant personalities. For an idea of the differences, take a look at . . .

Talks Reveal Dissimilar Maintenance Viewpoints

PETROLEUM REFINER'S maintenance editor took notes during a round table discussion of maintenance in petroleum processing plants at the Plant Maintenance & Engineering Conference, Cleveland, January 27, 1959. The ideas presented show that maintenance men have definite ideas on how to maintain *their* plants. Sometimes these ideas are diametrically opposed to other practices in the industry. Who's right? We'll let you read the viewpoints and decide for yourself.

Foremen. Atlantic reported that they have both area and craft foremen. The craft foremen move around the refinery areas directing the special crafts under their jurisdiction. The craft foremen report to the area foreman because it is naturally the job of the area foreman to coordinate the work being done in his area.

The Texas Company is just starting a multicraft foreman system. Humble has had this system for some time and says that there is no problem caused by the fact that the multicraft foreman is not highly skilled in craft work which he supervises. His main job is to keep the men in his crafts working—this takes leadership, not craft skill.

Texas City Refining Company uses craft foremen on a consulting basis. If the area foreman needs special craft supervisory help, he calls in the craft foreman to work out the problem. With this setup, the question arises as to who handles grievances. The answer is the craft foremen. It's true that they act as consultants but they also keep the time of the men in their craft and handle craft grievances.

One pont brought out on craft foremen was that the larger the plant, the more difficult it becomes to rotate the craft foremen.

Planning and Scheduling. Humble's Baytown refinery uses seven zones with a planner in each zone. Central Planning coordinates the planning and scheduling and moves manpower between the zones.

Humble uses one planner for every 36 hourly employes. If you included clerks, the ratio is one to 48. Phillips Petroleum and Canadian Oil Company Ltd. reported that their operations are similar.

All work at Humble starts with a work request which gives the sequence of work to be done, the number of craftsmen required and the estimated time to complete the job.

Emergency Jobs. One problem with tight scheduling, according to Phillips, is that emergency jobs interrupt the scheduled jobs. They tried a plan of setting aside mechanics to handle emergency jobs but found that it was better to schedule all of the available manpower and interrupt the schedule for emergencies. After operating under this system for some time, Phillips noted that emergency jobs dropped to 3 percent of the total work requests.

Esso states that their area engineer makes the estimate of manhours required on the job but the foremen have the power to change it. One refiner disagreed on the ground that it was a waste of engineering talent to use area engineers for making man-hour estimates. He felt that estimating should be done by the area supervisors.

Preventive Maintenance. Ethyl's Baton Rouge plant schedules 20 percent of its work as preventive maintenance. Fifty percent of its electrical work is on a preventive maintenance basis.

The majority vote on the question of how much preventive maintenance was done indicated that it amounts to 10-20 percent of the total maintenance work.

One refiner pointed out that you should consider some turnaround work as preventive maintenance. Some companies, like Du Pont, feel that most turnaround work is preventive maintenance work.

Another said that he checked on the various crafts in his refinery and found that they were spending about 25 percent of their time on preventive maintenance. He thought that even a summary check would show that preventive maintenance time was higher than ordinarily believed.

One problem stated with preventive maintenance is that for a high percentage PM program, the plant must carry a high inventory of spare parts.

Contract Maintenance. Canadian Oil Company, Ltd. uses contract maintenance crews on some of their turnarounds. Contract men get more pay than fulltime employes (Standard of Ohio say $1 per hour differential), but after the job is complete, the contract men are probably out of a job. So, the plant men get along fine and feel secure in their fulltime employment.

Union Carbide says that a Contractor's price for a job would be double that for plant employe-performed jobs.

One refiner replied that Carbide's statement was true but that total maintenance costs are less because you need fewer fulltime men and only use contractors for peak loads.

Canadian Oil Company reports that their total maintenance cost, as a percent of plant investment last year, was 2.8 percent versus the API reported average of 4 percent. They attribute this low figure to the use of contract maintenance labor on peak loads. ##

Air Conditioning Cuts Vessel Maintenance Costs

Portable ice air conditioners provide cool air for process vessel maintenance work. Result—increased work output with cheaper, safer and faster jobs

L. J. Cormack and M. L. Tackney
American Cyanamid Company, Avondale, La.

HOW WOULD you do repair work under hot, dusty and irritating conditions? The Fortier Plant of American Cyanamid Company, located near New Orleans, has an answer to this problem—a portable air conditioner. This unusual application of air conditioning speeded up the job, reduced the manhours required, lowered costs, and reduced skin and eye irritations to an all time low.

Oxygen Plant Cold Box. The Fortier personnel were confronted with unusual problems of testing and repairing the "cold box" of their tonnage oxygen plant. The production of tonnage oxygen requires that the process vessels operate at temperature below minus 200 F. The vessels are housed in a large steel box which had the walls and ceilings insulated with glass fibre and the floor insulated with several feet of mineral wool insulation. The box is divided into compartments, some of which are completely filled with insulation enclosing the process vessels. The process piping and instrument lines pass through and in many cases are buried in the insulation.

It is imperative that all leaks be located and repaired on the turnaround. The system is charged with refrigerant and an electronic leak detector is used for checking piping and gasketed joints. This requires the removal of a considerable amount of insulation to locate and explore all leaks in the system. When the insulation is removed from the box during repair, it requires rented semitrailers to store it for reuse. There are as many as 20 mechanics who are testing, checking and repairing the piping and pressure vessels. Others are working removing and replacing the mineral wool and glass fibre insulation. This activity causes a high concentration of insulation fibres to "float" around inside the "box."

The box had no opening at the top to aid in ventilation and the use of outside fans with flexible ducts to the inside did little to help conditions other than to agitate the air and stir up dust.

It was necessary that the work be done during the warm weather months and as a result the box was hot and stuffy. Personnel perspired and the insulation and dust adhered to the exposed skin and wet clothing. The particles would work through the clothing to the skin and cause irritation to many parts of the body.

The working conditions were far from ideal, because of heat, high humidity, lack of ventilation and insulation dust. The employes' effectiveness and output were low because of these discomforting conditions. After a few hours, the mechanics broke out in a rash from irritation of the insulation and dust, which also caused irritation of the eyes, throat, and nasal passages. All the well known precautions were taken, respirators, goggles, protective creams, etc. The respirators and goggles did provide some protection but added more discomfort to employees and further reduced their output. The use of protective creams on exposed parts of bodies provided some relief, but only eliminated part of the symtoms not the cause.

Because of the heat, high humidity and dust the "box" was certainly an uncomfortable place in which to work. One of the first things tried was to tie the mechanics' shirt sleeves, pants legs and wrap a cloth around their neck. This helped to prevent dust from getting under their clothing. However, when their clothes became wet from perspiration, the insulation dust would adhere and work through.

The supervisors noticed that at night when the air was cooler and the employes did not perspire, their output was higher and skin irritation cases were far less than on the day shift. The idea of cooling the air to provide better working conditions was investigated, however, because of the size of the box, and by necessity, a once through air system would require several tons of refrigeration. A permanent mechanical air conditioning system, requiring a large capital investment, was ruled out on the basis it would be needed only a few days each year.

The plant management then began a study of a portable mechanical system; many problems were encountered such as whether to use electrical driven or gas driven equipment in conjunction with an air or water cooled system. If electric power was used, the unit could require current at times when the electrical system was isolated for repairs or changes. The use of gas driven equipment would further increase cost of installation. In addition, if a water cooled system was used, it must come from the cooling tower supply. Here again was a conflict since electric power is used to operate the towers and the towers might be shutdown for regular maintenance during the time the tonnage oxygen plant was being serviced. If air was used as a coolant, the facilities necessary would increase the cost of a large portable unit. Our re-

quirements necessitated the use of a portable, easily moved unit with a capacity of 30-40 tons, having a low investment cost per ton of capacity.

A unit was found which had a low first cost per ton of capacity, was portable, and could provide air in quantities desired. The cooling was provided by the age old principle of melting ice thus eliminating the need for a large, heavy mechanical refrigeration system. The only electrical power required was for the electrical driven air moving fan and a small circulating pump. The unit was supported on a portable four wheel trailer supplying 40 tons of air conditioning with an air capacity of 12,000 cfm. The unit was obtained on a trial basis and located near the cold box. The cooled, dehumidified air was piped into the box through a large flexible hose.

The results were far above expectations. The work output of employes was higher and fewer rest periods were required. The cool, dry air eliminated perspiration on the skin and insulation fibre did not adhere and irritate, immediately reducing skin rash cases. The cool, dry air minimized the discomfort of wearing respirators and eliminated the problem of fogging goggles. The air discharged near the top of the box and being cool, flowed downward carrying dust and fine particles out of the box openings. This reduction in dust eliminated the need for goggles and respirators for much of the work inside the box. A check of statistics indicates a reduction of 300 percent in skin rashes and 500 percent in eye irritation cases.

In actual practice the operational costs were found to be less than estimated. Heavy refrigeration consumption was confined to only a few hours during the day and nominal consumption for the balance was less than originally estimated.

Although no accurate data is available, the supervisory personnel firmly believe the savings in three cold box overhauls will more than pay for the purchase price of the unit. The installation of two additional cold boxes in the expanded plant indicates the capital investment will be recovered in one year.

The plant management felt conditions could still be improved and continued to investigate the problem from a safety and hygiene standpoint. It was decided to supply each employe working in the box with two pairs of coveralls, each day, and men were instructed to take a shower and change coveralls at midshift. Experience indicated that this practice did not give an appreciable reduction in skin or eye irritation. This indicated the conditioned air was so effective that little else could be done to improve the working conditions. Based on this experience, a unit was purchased and immediately other applications for its use developed in the plant.

Cooling Process Reactors. In one department, brick lined reactors are used as process vessels. In operation, it contains a solution which is toxic and corrosive to the skin and eyes. When the reactors are removed from service for maintenance they are washed and steamed, but it was impossible to remove the last traces of corrosive solution because the bricks are porous; the solution penetrates and remains in the brick lining. The employes working in the reactor created a dusty atmosphere by disturbing the toxic material adhering to the brick wall. This dust then adhered to their exposed skin and perspiration dissolved the dust forming an irritating solution resulting in severe skin and eye irritation. All known precautions and equipment such as respirators, goggles, protective creams, etc., were used.

Some employes suffered eye irritations even though goggles were worn. It was found that perspiration on their forehead ran into their eyes when the men removed their goggles after leaving the vessel. To eliminate this possibility, another employe was stationed outside of the vessel with clean cloths to wipe off the men's foreheads and exposed surfaces before removing goggles and protective clothing.

Here again, the irritating dust, with perspiration, created very undesirable working conditions. Air blowers were tried but because of high humidity and high summer temperature men continued to perspire and suffer from skin irritation. The portable air conditioning unit was connected to the reactor and conditioned air fed into the unit. The employes were able to work in comfort and did not perspire. The toxic dust was present but did not adhere to their skin and form an irritating solution. Again employe output was increased, and another job was done cheaper, safer, and faster. These improved hygienic conditions are of untold value to the employes' health and morale.

The portable air conditioner is another tool available to plant maintenance personnel. As costs become more important, it will increase in value as an essential piece of plant equipment. There is an unlimited field for its use, in not only improving working conditions, but in reducing down time of the units.

The portable air conditioner can be used to cool and ventilate many kinds of hot or contaminated process equipment and with cool conditioned air, workmen will be able to enter and commence repairs sooner. Experience has indicated that when working with cooled and dehumidified air their output will be appreciably higher than under normal conditions encountered in process equipment. ##

About the Authors

Cormack Tackney

L. J. Cormack is general superintendent in the Mechanical department of American Cyanamid Co.'s Fortier plant, New Orleans, where he is responsible for maintenance and repairs of the petrochemical plant. He has a B.S. degree in electrical engineering from Oklahoma A&M College, and 20 years' experience in operation, inspection, design, construction, and maintenance of power plants, oil refineries and chemical plants.

M. L. Tackney is director of safety and fire prevention at American Cyanamid Co.'s Fortier plant, New Orleans. Tackney majored in education while in school, and graduated from Scollard Hall College, Ontario, Canada, in that subject. He has 19 years' experience in safety and fire prevention work.

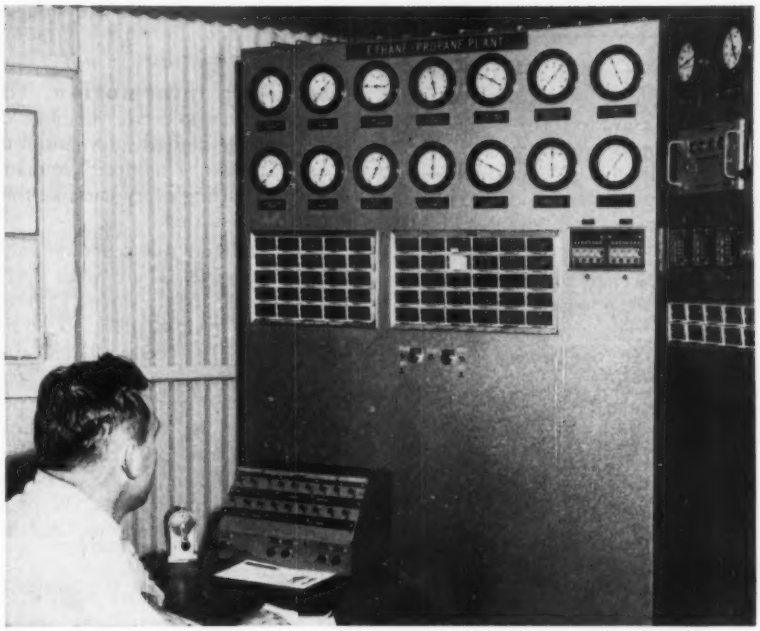

FIGURE 1—The ethane-propane recovery section is one of three monitoring panels. It includes indicating receiver gages, annunciators and engine graphics. On the desk is an rpm switch box allowing any machine monitored to be connected to a digital tachometer. When alarm shows on the panel, attendant signals the proper man in the area by a bell. This man carries a sound powered telephone which he plugs in, permitting two-way conversation between any point in the area and the monitoring house.

Monitoring Justifies New Unit

To make an ethane-propane recovery unit pay out, La Gloria had to dig deeply into advanced monitoring systems

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THE MONITORING SYSTEM in La Gloria's new ethane-propane recovery unit is the key to the plant's pay-out. When the new unit was first considered, operating costs looked too high to give a reasonable pay-out. But a study of operators' duties in the old plant and new instruments available showed a different picture. Here's how La Gloria went about designing the new unit.

The new unit had to be adjacent to the existing compressor and absorption area. Operating here were:

- Twenty-four gas-engine compressors, totaling 19,500 hp
- Two 4-cell cooling towers
- One 2-cell cooling tower
- Five absorbers
- Three dehydration units
- Necessary appurtenances.

Old Plant Studied. Two compressor operators and two oilers per shift operated the old plant. If their duties could be arranged so that another operator wouldn't be necessary for the new unit, then the plant could be justified.

A study showed that the two operators spent most of their time patrolling their area trying to spot trouble and that about half of this time was in walking from place to place. Oilers' time was divided about 40 percent checking temperatures and speed of engine-compressors and 40 percent to observing, pouring, and recording lube oil used. The remaining 20 percent was spent cleaning equipment. In both cases, the men could perform more important functions if some of their manual operations were done automatically.

The first duty studied was the time oilers spent on lube oil. If a small inexpensive meter was placed at each engine, with a level control on each forced-feed lubricator box,

the 40 percent would be reduced to 5 percent. This looked so good that we decided to do it at once. Saving in lube oil alone has paid out this equipment.

Next, we attacked the temperature and speed observing and the patrolling problems. If we could bring the temperatures and speeds together with essential pressure, flow and level readings to a central point, a large percentage of all the men's time could be used to better advantage on other duties.

A conservative estimate indicated 10 hours would be available per shift from the four men. They could use this time to operate the new unit; and therefore, an additional operator would not be necessary. This meant four men, one per shift crew; and we have four crews. Wages for four and one-third men must be considered to maintain four shift men, because of vacations, sick leave and other absences. This would be a very substantial saving and would probably allow construction of the new unit.

We now had to convince the operating crews that the changes in operating practices would be good business. In our case this was not difficult as all supervisors were stockholders and all employes were members of the La Gloria Employes' profit sharing trust. When it was explained to them that profits depended on building the new unit and operating it at an absolute minimum cost, about 90 percent became enthusiastic supporters and the other 10 percent accepted it with tongue in cheek.

Centralizing Information. The next step was to study methods of gathering the desired information at a central point. Therefore, we made a schedule listing every variable that could be measured.

The totals on this schedule were quite impressive. There were 2,515 temperatures, 153 pressures, 75 flows (half being gas), 8 pH's, 55 liquid levels, and 110 speeds all desirable to known, but many required observation only once or twice per month. The list reduced to those points that had to be held within limits for efficiency or safety included: 348 temperatures, 30 pressures, 30 flows, 32 speeds, and all 55 levels.

It was decided that the tempera-

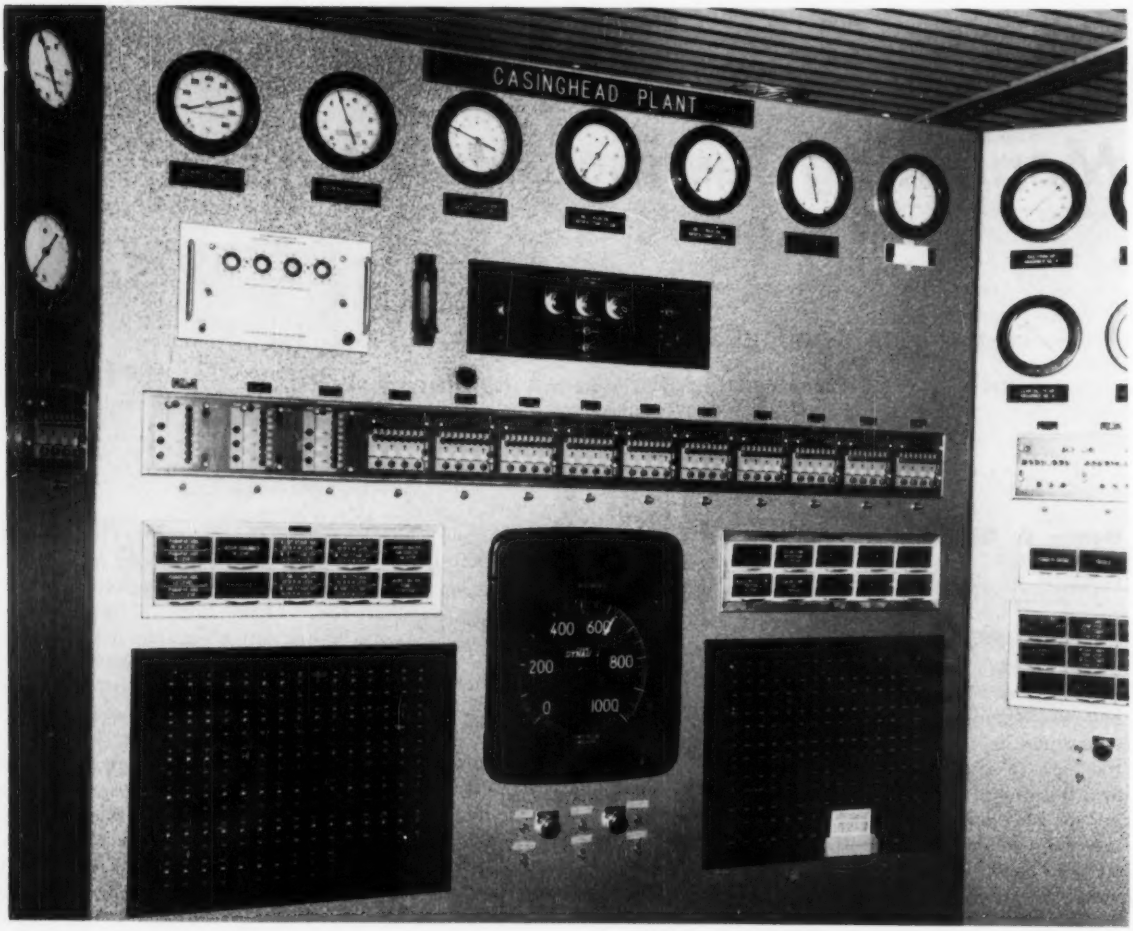

FIGURE 2—The center panel is for the compression section. Besides receiver gages, engine graphics and annunciators, there is an indicating tachometer for all compressors and a few pumps; scanner control and test panel; and potentiometer.

tures, pressures, flows, and speeds should be scanned and the levels monitored. Quotations asked of manufacturers were for full data reduction units complete with automatic typewriters, etc. The prices were more than we could justify, so we started thinking along another slant.

This next step was to determine which variables should be recorded, which indicated, and which only alarmed (when off normal). Also, several of the recorded and indicated items should be alarmed on abnormal readings. Our determinations showed two pressures should be recorded on analog charts and alarmed when off normal; moisture content of dehydrated gas recorded on analog charts but not alarmed; four temperatures should indicate on demand but did not need alarming; 348 temperatures did not require either recording or indicating but should be alarmed when off normal high, and 208 of these should alarm off normal low as well as high.

Another pertinent fact was that 326 temperatures would have thermocouples as primary elements. A further decision was made to continuously indicate on pneumatic receiver gages, 9 liquid flows with none alarmed; 10 gas flows, none alarmed; 2 differential pressures, both alarmed when high; 2 speeds in rpm, both alarmed when low; 5 pressures, two alarmed, one high and one low; and one level, to alarm at four points, approaching low or high and at extreme low or high.

It was also known that we would have two engine-compressors in the new unit which would make a total of 26 machines. In addition to the items already enumerated, all engines would each have a lube oil pressure to be alarmed when below normal, but would not require indication; and an rpm value that should be indicated on demand and alarmed when below normal. The 55 monitored levels were divided into 15 to alarm at four points; 11 to alarm at two points, high and low; and 29 scrubbers to alarm if liquid reached them. There were 12 pumps, 23 fans, and 3 turbine driven compressors to be monitored and alarm if they stopped for any reason. The rpm of the compressors should be indicated upon demand.

At this point we worked up a detailed pamphlet of specifications and talked to the manufacturers again asking for quotations for a unit built to these specs. After studying new quotations, we decided we could justify the expense to management, except the rpm monitoring and digital indication. We decided to make this a separate item to be engineered and built by ourselves.

FIGURE 3—Third panel is for high pressure gas compression and absorption section. Below receiver gages and engine graphics are dehydrator indicators, annunciators and a recorder (giving water in pounds per million cubic feet of gas feeding to pipelines).

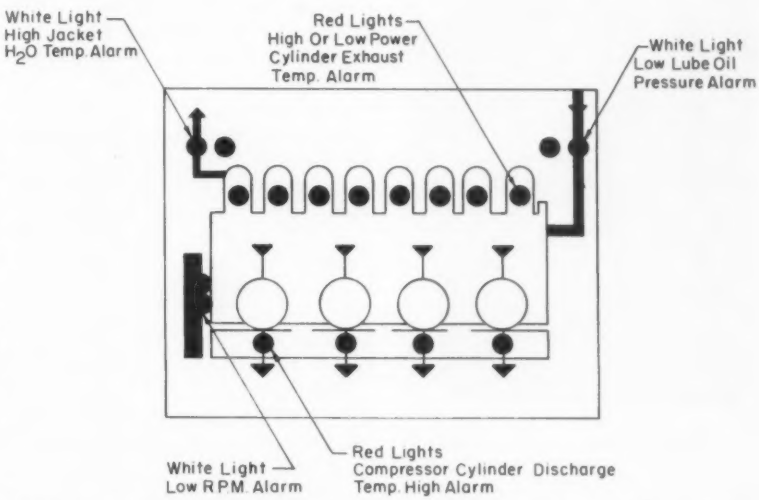

FIGURE 4—Schematic for engine graphic. Compressor discharge temperature, if above normal, warns of troubles such as leaking or broken valves, bad piston rings or lack of lubrication.

Final Selection. The unit finally selected is built in three panel front cubicles and its heart is a 330 point temperature scanning system. The scanner will operate at any selected rate from one to five points per second. It has pin board alarm setting for each individual point. The temperature of the engine power cylinder exhausts are visually alarmed above and below normal on the same light.

Monitoring Justifies New Unit . . .

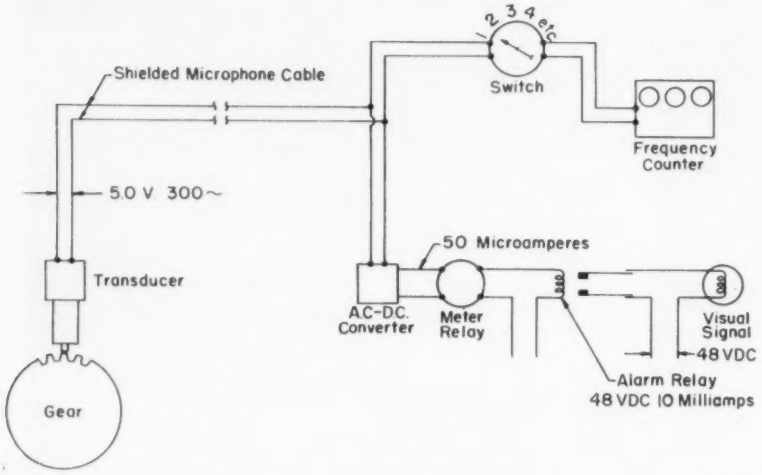

FIGURE 5—Schematic for rpm monitoring and measuring system. Impulse wheel, mounted on engine, will turn at the same rpm as engine crankshaft. Transducer produces an AC voltage with a frequency equal to the wheel rpm. Tachometer counts the cycles per second. The monitoring is done by rectifying the AC voltage and producing a DC current measured by a meter-relay.

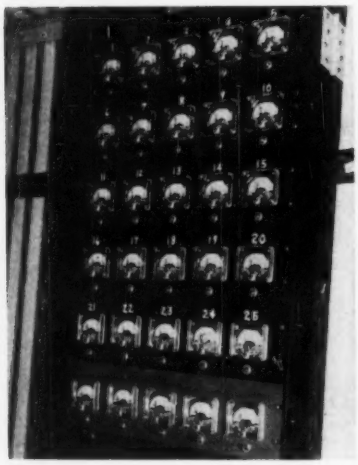

FIGURE 6—Bank of meter relays.

A potentiometer is incorporated in the scanning system allowing any thermocouple temperature to be indicated on demand. This potentiometer is used to determine whether an exhaust temperature is alarming for off normal high or low.

Alarm Example. When the jacket water is off normal high, the engine is shut down automatically. The white light on the jacket water line starts flashing and a chime commences sounding. The man on duty notes engine number and acknowledges signal, which silences chime and causes light to stop flashing and come on steady. This group of three alarms per engine are known as "First Out Alarm," which means when one works, the other two are "locked out" and will not function when an engine stops. The jacket water signal will remain lighted until water temperature decreases to normal. Jacket water and lube oil signals reset automatically on normal readings, however, the rpm light must be manually reset.

Savings in Operation. The monitoring system has exceeded our expectations. The engine compressors have been operated more efficiently and with less down time as trouble is spotted sooner than before the monitor was installed.

Two power cylinders and pistons have been saved because an excessively high exhaust temperature was alarmed and trouble corrected immediately. Under former operating practices, the first indication of trouble would have been severe knocking or stopping of engine. Cylinders and pistons would have been ruined and replacement mandatory.

Many leaking compressor valves have been detected long before they would have been without the monitoring system. One broken valve was found before the compressor cylinder liner and piston failed because of heat. This happened so fast that the operator barely got the engine shut down in time to prevent the damage. We also think we saved 20,000 pounds of silica gel dessicant in our dehydrators by having an early alarm of a level getting high due to a broken regulator stem.

As surmised in our first analysis, the additional man to operate the new unit is not necessary. The compressor operators actually have more time to perform their present duties, even with the new unit included, than they did under the former operating conditions.

The two oilers on shift alternate attending the system. They stay in the monitoring house two hours and in their respective field area two hours. Everyone, even the "tongue in cheekers," are happy with the present operation.

About the Author

Homer C. Givens has spent 28 years in all phases of construction and operation of natural gasoline plants. Superintendent of La Gloria Oil and Gas Co.'s cycling and natural gasoline plant at Falfurrias, Texas, Givens joined the company as chief operator in 1941. Prior to that he spent almost eight years with Shell Petroleum Corp. in the Natural Gas-Gasoline department, and almost three years in the same department of Gulf Oil Corp. Later, he spent six months with Natural Gasoline Plant Construction Co., where he engineered and supervised the construction of a natural gasoline plant near Grand Rapids, Mich. Givens received his B.S. degree in mechanical engineering from Oklahoma A & M College in 1929.

Original presentation was before the Symposium on Instrumentation for the Process Industries, A&M College of Texas, January 21, 1959.##

Get More Cracker Feed from Residua

A new improved deasphalting process is being used at Humble's Baytown refinery to recover catalytic cracking feed stock from crude residua

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Baytown, Texas

THE PROBLEM of optimum utilization of crude residua continues to be of primary importance to the petroleum refiner despite the considerable progress in this field through the years. The present interest in this problem stems from the fact that even with today's modern and efficient pipestills, a considerable amount of heavy gas oil remains in the residuum. Economic credits for elevating this gas oil from Bunker "C" fuel oil to catalytic cracking feed are $1-2 per barrel. In the past, improved utilization of residua has been brought about both by advances in distillation techniques and by thermal cracking (visbreaking) of the bottoms from distillation. The extent of this improvement is indicated in Table 1.

While the role of distillation has been important in the past, further reduction in fuel oil by deeper flashing of crude bottoms will be difficult. This is due not only to the physical limitations involved, but also to limitations imposed by volatilization of metallic components. These metal compounds, especially nickel and vanadium types, are recognized as cracking catalyst poisons and their concentrations in catalytic cracking feeds must accordingly be held to a minimum. Similarly, further reduc-

TABLE 1—Reduction in Residual Fuel Oil Basis: Minimum Fuel Oil Production from West Texas Crude

Period	Refinery Process	Vol. Percent on Crude
1920	Atmospheric Shell Stills	38
1930	Vacuum Shell Stills + Visbreaking	22
1940	Pipestills + Visbreaking	17
1952	Deep Vacuum Distillation + Visbreaking	13

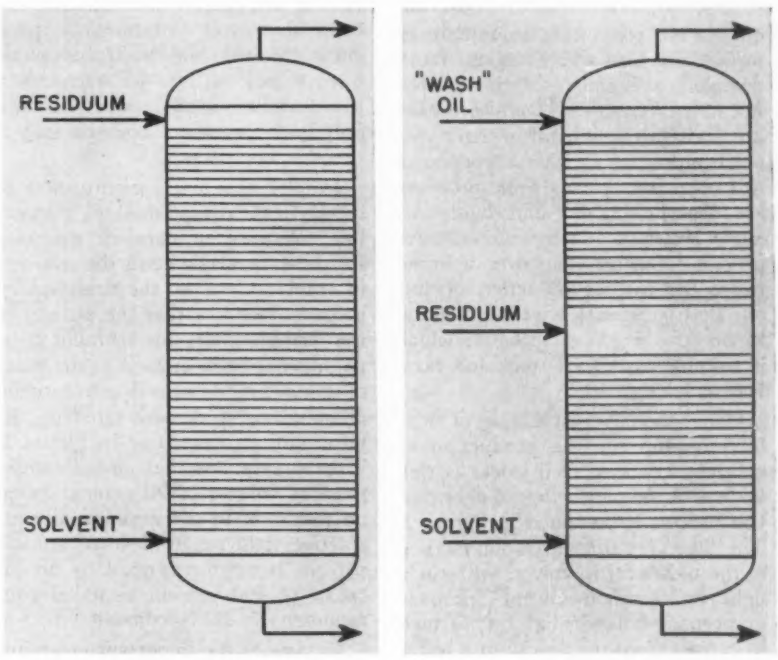

FIGURE 3—Here's the heart of this new, improved process. In the extraction tower (right), the wash oil is injected near the top, with residuum into the middle. This results in reduced metals content and better and more cracker feed stock.

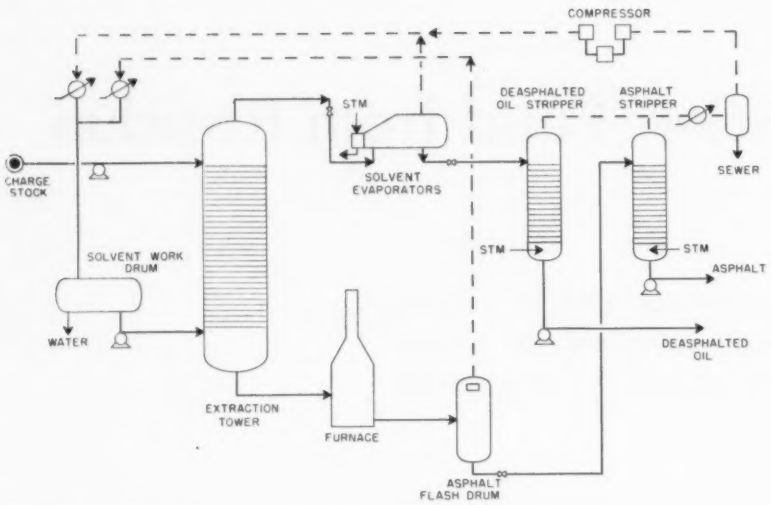

FIGURE 1—This is the conventional deasphalting of non-lube residua for cat cracker feed, using light hydrocarbon solvent in the extraction tower.

tions in fuel oil yield by means of visbreaking appear to be unlikely. Other processing methods are therefore needed to effect additional upgrading of residua.

The major requirement for new methods of processing residua is high selectivity for recovery of heavy virgin gas oils containing a minimum of metals and Conradson carbon. While complete attainment of this goal is not now foreseeable, several processes are available which permit the achievement of at least a portion of this objective. Among these processes are deasphalting[1,2,3] and fluid coking[4,5] either of which is an effective process for controlling over a broad range the further reduction of fuel oil. Both processes have been found to produce a gas oil product which is suitable as a feed stock for catalytic cracking

Conventional deasphalting of non-lube residua for the production of catalytic cracking feed stocks is well known. A simplified flow diagram of this process is presented in Figure 1. The "heart" of this separation method is the extraction tower, wherein a light hydrocarbon solvent (propane or propane-butane mixtures) is used to extract from the residuum a heavy deasphalted oil which is subsequently charged to catalytic cracking. The asphaltic residue withdrawn from the bottom of the tower is blended to fuel oil either directly or after visbreaking. Equipment other than the extraction tower consists of heat exchangers, pumps, and vessels necessary for recovery and recirculation of the solvent present in the two streams leaving the tower. The process is well proven and highly flexible, and because the metal contaminants (present in the feed) and the asphalt phase have a high affinity for each other, the deasphalted oil product contains only trace amounts of these objectionable compounds.

Despite the low concentration of metals in the deasphalted oil, the very low tolerance of catalytic cracking for these materials limits the recovery of cracking feed by the deasphalting process. The fact that the affinity of the asphalt phase for metallic compounds has been utilized to the point of diminishing returns in conventional deasphalting is demonstrated by the information presented in Figure 2. This curve shows that an increase in product volume of 20 percent based on residuum in the economically attractive yield range of 40-60 volume percent is accompanied by an increase of 400 percent in metal contaminants in the product.

In view of the importance of minimizing contamination of the catalyst in the cracking operation, consideration was given to possible modifications of the deasphalting process which might further improve its selectivity. The most promising approach appeared to be one which utilized the fact that high molecular weight aromatic ring structures have an affinity for metallic components. Using data similar to those shown in Figure 2, it can be calculated that the metals concentration in the asphalt product is 10 to 50 times greater than that in the deasphalted oil, the precise value depending upon feed stock, yields, and operating conditions. Observations of this phenomenon led to the concept of developing a wash operation in which a third stream would be injected into the upper section of the tower and allowed to flow downward countercurrent to the deasphalted oil solution.

The characteristics required for a satisfactory wash agent were that it should be largely insoluble in the deasphalted oil solution, should have a high affinity for metals, and should have a low metals content initially. Removal of the metals from the deasphalted oil solution by the wash technique would be limited only by the amount and effectiveness of the wash agent and the number of countercurrent contacting stages employed. Two synthetic asphalts, both derived from catalytic cycle stocks and possessing the above characteristics for a satisfactory wash oil, have been developed. An additional feature of these stocks is that both are normally components of fuel oil. Thus, in commercial practice the wash oil is allowed to continue down the tower and is withdrawn from the bottom in admixture with the natural asphalt. The mixture can be blended directly to fuel oil or visbroken for further reduction of fuel oil volume.

Initial Laboratory Studies on Thermal Tar. Initial studies were conducted using a batch high pressure rotary unit which had been specifically designed for use in deasphalting studies wherein contamination of the products from external sources (such as packing glands of mixing shafts) was held to a minimum. This equipment is similar to that described by Ditman and Mertens.[6] The residuum feed used was an average mixture of non-lube residua produced at Baytown. The wash oil chosen for this preliminary evaluation was tar derived from thermal cracking of cata-

TABLE 2—Results from laboratory batch deasphalting studies.

Run	1	2	3
Feed Stock	Residuum	Wash Oil	80 Percent DAO From Run 1 20 Percent Wash Oil
DAO Yield—Vol. %....	60.3	58.5	91.9
DAO Inspections			
Nickel—ppm.....	1.5	0.06	0.51
Vanadium—ppm.....	2.0	0.06	1.1
Con. Carbon—Wt. %	4.4	1.8	4.0
Specific Gravity— 60/60 F.....	0.9382	1.0087	0.9613

TABLE 3—Results from pilot tower deasphalting studies

Run Number		4	5
Feed Stock	AVERAGE RESIDUUM		
Type Wash Oil Used....	.....	None	Cat. Cycle Stock Thermal Tar
Percent Wash Oil Used*.	.....	.....	25
DAO Yield—Vol. %*...	.....	48.4	53.5
DAO Inspections	Feed		
Specific Gravity— 60/60 F.....	1.0094	0.9451	0.9638
Conradson Carbon— Weight %.....	18.7	4.4	4.1
Nickel—ppm.....	47.6	2.0	0.6
Vanadium—ppm.....	53.1	2.8	0.8

* Based on Residuum Feed.

TABLE 4—Results from batch deasphalting studies using reduced thermal tar and reduced cycle stock.

Run	6	7	
Feed to Deasphalting	100 Percent Unwashed Deasphalted Oil	80 Percent DAO from Run 6 20 Percent Reduced Thermal Tar	80 Percent DAO from Run 6 20 Percent Reduced Cat. Cycle Stock
DAO Yield—Weight Percent.....	100	78.6	77.6
DAO Inspections			
Specific Gravity—60/60 F.....	0.9432	0.9353	0.9474
Nickel—ppm.....	2.34	0.78	0.66
Vanadium—ppm.....	3.33	0.94	0.93
Con. Carbon—Weight Percent.....	4.4	4.0	3.8

lytic cycle stocks. This material was chosen not only because of its "asphaltic" nature and its low metals content, but also because of its ready availability.

The original concept of the wash oil process assumed that the wash oil would be injected near the top of a deasphalting tower which was processing a non-lube residuum being injected near the middle of the tower. A simplified comparison of the conventional and modified extraction towers is presented in Figure 3. In an effort to duplicate this type of operation, the following treating sequence was carried out using the previously mentioned batch equipment. First, the average residuum was deasphalted alone and base case deasphalted oil quality obtained. Second, the deasphalted oil from this operation was blended with a known amount of thermal tar, and this blend deasphalted under identical conditions as used for the base case run. Deasphalted oil yield and quality data were also obtained on the thermal tar alone, using the same deasphalting conditions. The results from this batch study are presented in Table 2.

Comparison of the nickel and vanadium contents of the deasphalted oils (Table 2) shows that the tar wash technique was very effective in reducing metals content of oil produced from the residuum. The reduction obtained is significantly greater than would have occurred from dilution effects alone; that is, by direct blending of the deasphalted oils from the wash oil and the residuum. It will also be noted that coincidental with the significant metals reduction, a specific gravity increase on deasphalted oil also occurred. This was due to the fact that gas oil boiling range material present in the thermal tar was soluble in the solvent phase and, hence, became part of the deasphalted oil solution.

Past studies have established that the gas oil portion of catalytic tar is undesirable as a catalytic cracking feed stock. Therefore, it was recognized at this point that contamination of the total deasphalted oil with the wash oil could become a limitation. The over-all results from the batch studies were sufficiently encouraging, however, to warrant a firm evaluation of the wash technique using a pilot tower deasphalting unit. The unit employed is typical of commonly available laboratory deasphalting equipment and consists of a 32-foot high 4-inch diameter tower, appropriate pumps, charge drums, control instruments, and back end stripping equipment. Residuum and wash oil charged to the pilot unit were the same as those employed in the batch study. The results of this work are summarized in Table 3.

These data (Table 3) clearly illustrate the effectiveness of the wash oil technique in reducing the level of metal contaminants in the deasphalted oil product. Also shown, however, is the excessive solubility of tar fractions in the deasphalted oil indicated by the batch data. Further work on the catalytic tar was directed towards evaluating a stock from which the gas oil fractions had been removed by vacuum distillation. In addition to this work it was desired to develop an alternate wash oil to improve the flexibility of refinery operations. A logical choice for evaluation as an alternate wash oil was the residue which could be obtained

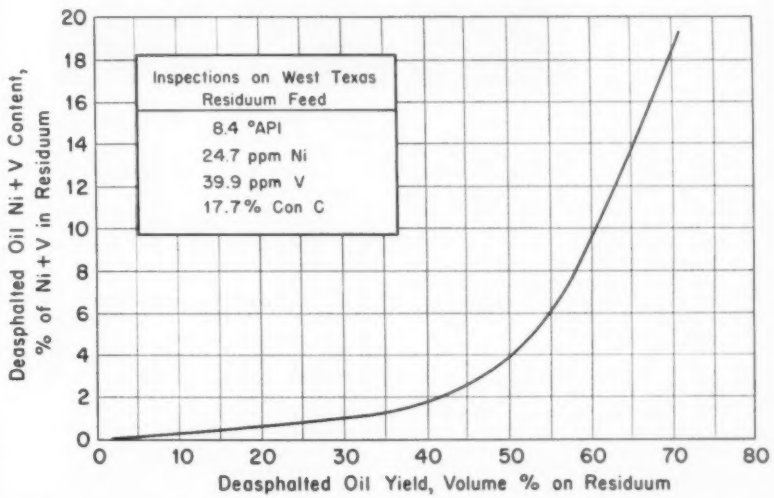

FIGURE 2—Conventional deasphalting has been pressed to the limit. Notice that an increase in product volume of 20 percent from the usual range of 40-60 volume percent gives an increase of 400 percent in metal contaminants in the product.

by vacuum distillation of cycle stocks. This fraction has a low metals content and consists of highly condensed ring aromatics which make it largely insoluble in the deasphalted oil phase.

Batch Unit Comparison of Reduced Thermal Tar and Reduced Cycle Stock. Initial evaluation of the vacuum reduced thermal tar and the vacuum reduced cycle stock was conducted on the batch unit. Rather than prepare a base case deasphalted oil on the batch equipment for this study, an unwashed deasphalted oil was used which had been obtained from previous pilot unit studies charging West Texas residuum. A batch run was made using this deasphalted oil without wash oil in order to make certain that no phase separation would occur on this stock at the conditions being employed. Results from this study are presented in Table 4.

These data (Table 4) show that both wash oils are very effective in removing metals. As shown by the specific gravity data, vacuum reducing the thermal tar prior to using it as a wash oil decreased contamination of the deasphalted oil with tar fractions.

TABLE 5—Pilot unit results using reduced thermal tar and reduced cycle stocks for deasphalting.

Run No.		9	10	11	12	13	14
Wash Oil Used		None	Reduced Thermal Tar	Reduced Cycle Stock	None	Reduced Thermal Tar	Reduced Cycle Stock
Volume Percent Wash Oil (Based on Resid.)		.....	14.8	17.2	.....	17.5	17.0
Deasphalted Oil Yield Vol. Percent		47.5	50.8	49.9	60.4	62.9	67.2
Deasphalted Oil Inspections							
Specific Gravity 60/60 F.	Feed 1.0113	0.9459	0.9503	0.9490	0.9578	0.9672	0.9683
Con. Carbon, Wt. Percent	17.1	3.8	3.4	3.0	5.3	5.4	5.4
Nickel, ppm	24.7	1.60	0.39	0.19	3.04	0.85	0.75
Vanadium, ppm	39.9	2.12	0.41	0.26	4.52	1.12	0.89

TABLE 6—Effects of various wash oil rates for deasphalting.

	9	10	15	12	13	16
Nominal DAO Yield, Vol. Percent	50	50	50	65	65	65
Percent Wash Oil (Based on Resid.)	0	14.8	26.0	0	17.5	44.3
Actual DAO Yield, Volume Percent (Based on Rasid.)	47.5	50.8	57.8	60.4	62.9	64.5
DAO Inspecitions						
Specific Gravity, 60/60 F.	0.9459	0.9503	0.9529	0.9578	0.9672	0.9634
Con. Carbon, Weight Percent	3.8	3.4	3.3	5.3	5.4	4.5
Nickel, ppm	1.60	0.39	0.28	3.04	0.85	0.38
Vanadium, ppm	2.12	0.41	0.29	4.52	1.12	0.52

Pilot Unit Comparison of Reduced Thermal Tar and Reduced Cycle Stock. On the basis of the batch deasphalting comparisons of the two types of wash oils a more comprehensive evaluation was conducted on the pilot tower deasphalting unit. The feed stock used in this study was a West Texas residuum. Operations with both wash oils were conducted at two deasphalted oil yield levels which were representative of the range of practical interest. The effectiveness of these stocks as wash oils at both yield levels is shown by the data in Table 5.

The effect of wash oil rate was also investigated in the pilot unit to establish the relationship between wash oil rate and product quality. The results of this study, which was made with West Texas residuum and the reduced thermal tar, are shown in Table 6.

These data (Table 6) show that additional metals reduction can be obtained by increasing the wash oil rate, and for the ranges studied, no marked leveling off of this effect was noted.

About the Authors

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J. E. Lawson is a senior chemical engineer in the Technical division of Humble Oil & Refining Co.'s Baytown refinery, where he works in process design, economic studies, and technical control in the fields of crude distillation and fuel products deasphalting. He received a B.S. degree in chemical engineering from the University of Texas in 1948.

J. P. Peet is a senior sales engineer for Humble Oil & Refining Co.'s Baytown refinery, where he provides technical assistance to management, industrial accounts, and equipment manufacturers on matters related to fuels and lubricants. He was with the Research and Development division at Baytown for 10 years doing process development studies of lube processes, processes for preparation of heavy feed stocks for cat cracking, and processes to improve residual fuel oils. He has also done studies on motor gasoline and lubricating oil product quality. Peet has a B.S. degree in chemical engineering from Rice Institute.

N. P. Peet is a senior research specialist at Humble Oil & Refining Co.'s Baytown refinery, where he makes engineering and economic appraisals of new refining processes to guide research and expedite commercial application. He has 15 years' experience in commercial processes and operations including cat cracking, hydrogenation, deasphalting, and distillation. He has been on his present assignment for two years. Peet received a B.S. degree in chemical engineering from Rice Institute in 1941.

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The authors wish to express their appreciation to the Humble Oil & Refining Company for permission to publish this paper. In addition, our appreciation is also extended, to our colleagues who assisted in the various phases of the development and application of the process described.

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Find Fuel/Air Ratio Graphically

By using this nomograph, with simple exhaust gas analysis, air/fuel ratios can be determined quickly

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Mellon Institute
Pittsburgh, Penn.

PRESENTED HERE IS a generalized hydrocarbon combustion chart which provides a direct and accurate interrelation between the fuel composition, the air-fuel ratio, and the exhaust gas composition. The mathematical relationships, derived below, are based on rigorous stoichiometric principles; the chart (Figure 1), however, includes two simplifying assumptions:

1. The combustion products contain no residual organic matter other than hydrocarbons; and
2. These hydrocarbons possess the same hydrogen-carbon ratio as the fuel.

The control of air and fuel feed rates in combustion processes is frequently based on the composition of the combustion products. For example, in conventional automotive engines breathing unmetered air, the exhaust gas analysis is employed for calculating the ratio of air-to-fuel in the inducted charge. Such determinations may utilize rigorous stoichiometric calculations, or they may be based upon empirical relationships or upon correlations involving simplifying assumptions.

Development of Chart. The air-fuel weight ratio may be specified in terms of exhaust gas composition as follows:

$$A/F = \frac{\Sigma O}{2}\left[\frac{29.0}{0.210}\right] \Big/ \frac{M\Sigma C}{n} \qquad (1)$$

where ΣO and ΣC, respectively, designate the total oxygen atom and total carbon atom content of the exhaust gas, and where n and M, respectively denote the carbon number and molecular weight of the fuel; the numerator and denominator within the brackets represent, respectively, the average molecular weight of air and the normal mole fraction of oxygen in air.

The total oxygen atom content of the exhaust gas (including that in any nitrogen oxides which may have been formed) may be specified as follows when the residual hydrocarbons contain no combined oxygen.

$$\Sigma O = 2\left[CO_2 + \frac{1}{2}CO + NO_2 + \frac{1}{2}NO + O_2 + \frac{1}{2}(H_2O)^+\right] \qquad (2)$$

In this relation, the term $(H_2O)^+$ represents the water formed in the combustion, which may be expressed as

$$(H_2O)^+ = \frac{1}{2}\left[CO_2 + CO\right]\left[\frac{H}{C}\right] - H_2 \qquad (3)$$

when the assumption is made that the unburned hydrocarbons possess the same hydrogen-carbon atom ratio, H/C, as the fuel.

The total carbon atom content of the exhaust gas is given by the relationship:

$$\Sigma C = CO_2 + CO + n'R \qquad (4)$$

where R represents the exhaust gas unburned fuel content and n′, the carbon number of the unburned fuel in the exhaust.

Since the molecular weight of a hydrocarbon may be expressed as

$$M = n\left[12 + \frac{H}{C}\right], \qquad (5)$$

the foregoing equations may be combined and rearranged to yield the following generalized relationship.

$$A/F = \left[\frac{69.0}{12 + \frac{H}{C}}\right]\left[\left(\frac{CO_2 + 2\,O_2 + 2\,NO_2 + NO - H_2}{CO_2 + CO}\right) + \left(\frac{2 + \frac{H}{C}}{2}\right)\right]\left[\frac{1}{1 + \left(\frac{n'R}{CO_2 + CO}\right)}\right] \qquad (6)$$

where $(n'R)/(CO_2 + CO)$ represents the atom ratio of hydrocarbon carbon to oxidized carbon in the exhaust gas. This equation thus expresses the air-fuel weight ratio for the special case in which the exhaust contains no residual organic matter other than hydrocarbons having the same hydrogen-carbon ratio as the fuel.

For the case in which the unburned fuel contains some combined oxygen or does not possess the same hydrogen-

* Present address: Southwest Research Institute, San Antonio, Texas.

Find Fuel/Air Ratio Graphically . . .

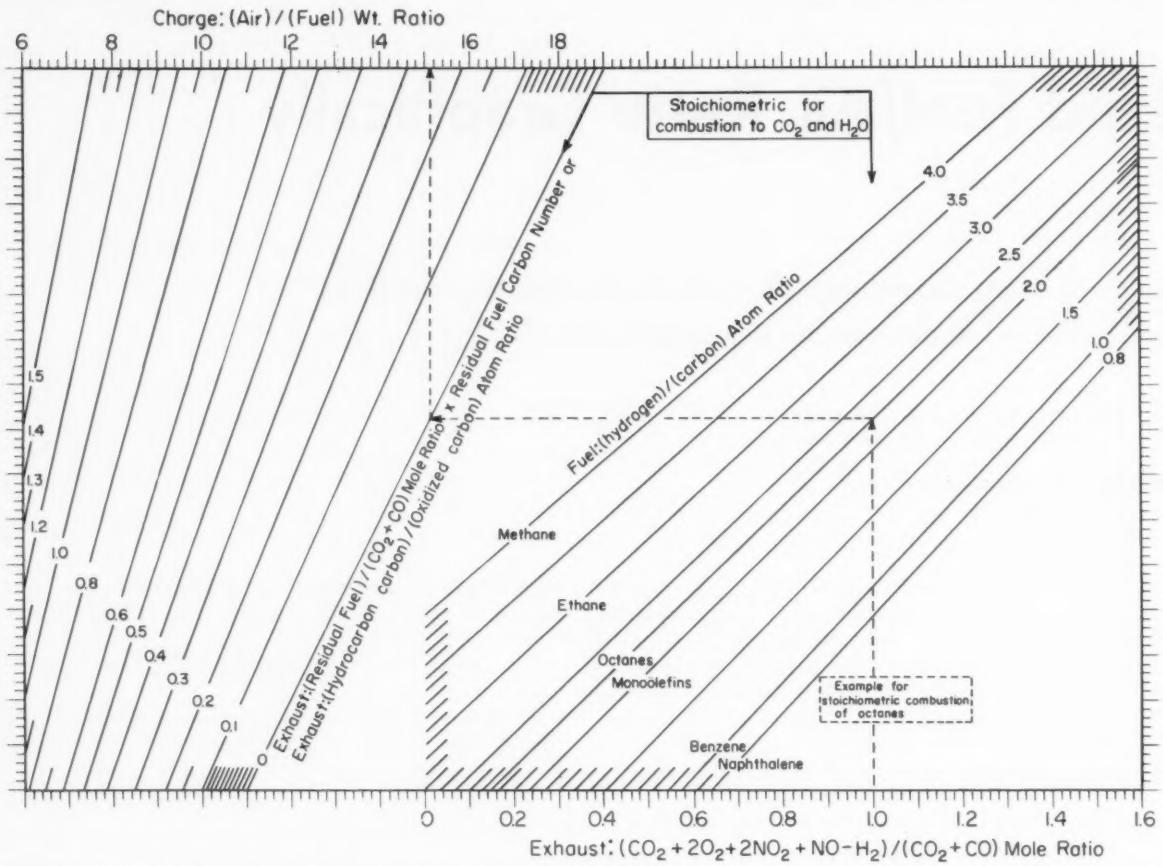

FIGURE 1—This hydrocarbon combustion stoichiometry chart assumes combustion products contain no residual organic matter except hydrocarbons having same hydrogen/carbon ratio as original fuel. The dashed line represents combustion to CO_2 and H_2O.

carbon ratio as the original fuel, the following rigorous expression for the air-fuel ratio may be derived:

$$A/F = \left[(A/F)_{eq.\ 6} \right] \left[1 + \frac{\left(\frac{n'R}{2}\right)\left(\frac{H}{C} - \frac{H'}{C}\right) + n'R\left(\frac{O'}{C}\right)}{(CO_2 + 2\,O_2 + 2\,NO_2 + NO - H_2) + (CO_2 + CO)\left(\frac{2 + H/C}{2}\right)} \right] \quad (6a)$$

where H′/C and O′/C refer, respectively, to the hydrogen-carbon and oxygen-carbon atom ratios of the unburned fuel.

Graphical representation of equation 6a leads to a cumbersome correlation; hence, the chart presented in Figure 1 was developed for the simplified case represented by Equation 6. This development included the following steps:

1. The term, $(n'R)/(CO_2 + CO)$ was set equal to zero, and the air-fuel ratio for this condition of no unburned fuel in the exhaust was plotted as the ordinate, yielding the family of curves at the right of the chart.
2. The air-fuel ratio for the general case (which includes unburned fuel in the exhaust) was then plotted versus this ordinate by varying only the ratio of hydrocarbon carbon to oxidized carbon, yielding the family of curves at the left of the figure.

Use of Chart. Because of the ratio form of the generalized equation and chart (Equation 6 and Figure 1), any units of concentration proportional to absolute molal quantities may be employed. For the same reason, the presence in the exhaust gas of water or diluents such as nitrogen and argon has no effect on the calculations.

Any reliable analytical method for measuring the exhaust gas composition should be suitable for use, provided it can determine the concentration (if significant) of all possible components. Appropriate methods might include Orsat analysis, gas chromatography, and mass spectrometry. Infrared absorption, employed alone or in conjunction with other analytical methods, should be especially suitable for measuring the ratio of hydrocarbon-carbon to oxidized-carbon.

The fuel hydrogen-carbon ratio may be determined by

ordinary combustion analysis, or it may be estimated from physical property data, such as boiling point and density, with the aid of generalized correlations.[1] When it is desired to express the air-fuel ratio as a molal ratio, the molecular weight of the fuel must be known. This quantity may be measured directly, or it may be estimated from physical property data.

The simple case of stoichiometric combustion of a fuel composed of octanes is illustrated in Figure 1 by a dashed line. This line represents ideal combustion to CO_2 and H_2O. For such a situation, there can be no carbon monoxide, hydrogen, oxygen, unburned hydrocarbon, or nitrogen oxides in the exhaust. Hence, the fuel hydrogen-carbon ratio is the sole variable which determines the stoichiometric air-fuel ratio. For non-stoichiometric cases, the chart may be utilized as illustrated for a hypothetical combustion process in the following examples:

Example 1—Determination of Air-Fuel Ratio for Hypothetical Combustion of Octanes

Measured ratio of unburned hydrocarbon (equivalent to original fuel)-to-carbon dioxide in exhaust.

$(n'R/nCO_2) = 0.007$

Measured exhaust gas composition (hydrocarbon-free basis):

Component	Mole %
H_2O	2.5
H_2	2.8
N_2	80.5
NO	Nil
NO_2	Nil
O_2	0.2
CO_2	12.4
CO	1.6
Total	100.0

$$\frac{(CO_2 + 2\,O_2 + 2\,NO_2 + NO - H_2)}{(CO_2 + CO)} = \frac{10.0}{14.0} = 0.715$$

$$\left(\frac{n'R}{CO_2 + CO}\right) = \left(\frac{n'R}{nCO_2}\right)\left(\frac{CO_2}{CO_2 + CO}\right)(n) =$$

$$(0.007)\left(\frac{12.4}{14.0}\right)(8) = 0.05$$

Air-fuel wt. ratio indicated by chart:

$A/F = 13.1$

Example 2—Determination of Unburned Fuel for Hypothetical Combustion of Octanes

Metered air-fuel wt. ratio:

$A/F = 13.1$

Measured exhaust gas composition (hydrocarbon-free basis):

Component	Mole %
H_2O	2.5
H_2	2.8
N_2	80.5
NO	Nil
NO_2	Nil
O_2	0.2
CO_2	12.4
CO	1.6
Total	100.0

$$\frac{(CO_2 + 2\,O_2 + 2\,NO_2 + NO - H_2)}{(CO_2 + CO)} = \frac{10.0}{14.0} = 0.715$$

Ratio of hydrocarbon-carbon to oxidized-carbon indicated by chart:

$$\left(\frac{n'R}{CO_2 + CO}\right) = 0.05$$

Calculated percent of fuel carbon not burned:

$$(100)\left(\frac{n'R}{CO_2 + CO}\right) \Big/ \left[1 + \left(\frac{n'R}{CO_2 + CO}\right)\right] =$$

$$(100)\,(0.05)/(1.05) = 4.8\%$$

Applications. The illustrated stoichiometry chart should be a useful tool for processing exhaust gas analysis data from any laboratory, pilot plant, or industrial combustion process in which hydrocarbons are burned with air. Greatest application would probably be found in the operation of stationary internal combustion engines, automotive, marine, or aircraft engines, and oil- or gas-fired boiler or furnace installations. With modifications, the chart could be extended in scope to handle fuels containing non-hydrocarbon constituents such as oxygen, sulfur, and nitrogen. Varying quantities of these elements occur in coal, shale oil, synthetic fuels, residual petroleum fuels, and, to a lesser extent, in certain petroleum distillates.

NOTATION

A/F	Air-fuel weight ratio
ΣC	Exhaust gas carbon atom concentration
ΣO	Exhaust gas oxygen atom concentration
CO, CO_2, H_2, $(H_2O)^+$, NO, NO_2	Exhaust gas component concentration
R	Exhaust gas unburned fuel concentration
n	Number of carbon atoms per molecule of fuel
n′	Number of carbon atoms per molecule of unburned fuel
H/C	Hydrogen-carbon atom ratio of fuel
H′/C	Hydrogen-carbon atom ratio of unburned fuel
O′/C	Oxygen-carbon atom ratio of unburned fuel
M	Average molecular weight of fuel

ACKNOWLEDGMENT

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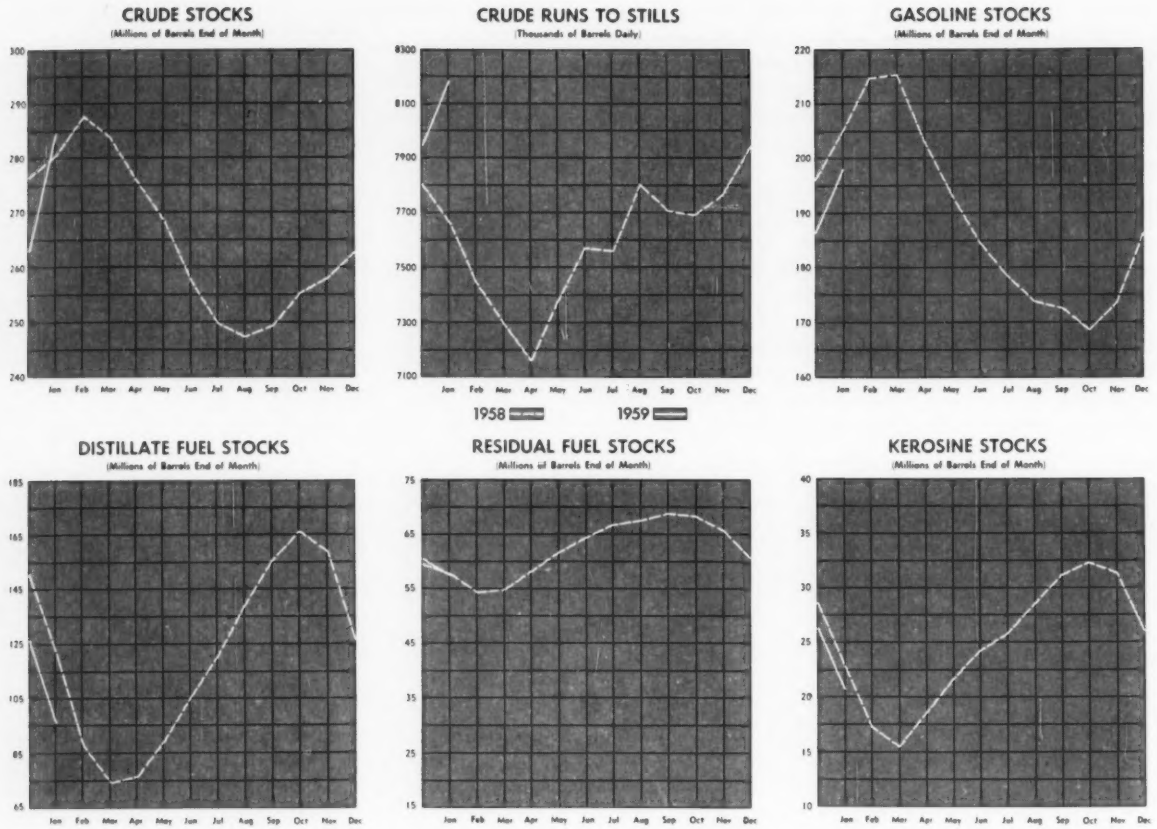
[1] Hougen, O. A., and Watson, K. M., "Chemical Process Principles, Part I" John Wiley & Sons, Inc., New York (1943).

About the Author

Dr. W. D. Weatherford, Jr., is a senior research engineer for the Southwest Research Institute in the Engines, Fuels, and Lubricants department. Formerly a fellow at Mellon Institute of Industrial Research, he handled the combustion research program, including shock tube studies of hydrocarbon preflame reactions and engine studies of abnormal ignition phenomena. He has a B.S. degree in chemical engineering from The University of Texas, and M.S. and Ph.D. degrees from the University of Pittsburgh. Weatherford was a process and research engineer for Neches Butane Products Co. for two years and was with Mellon Institute from 1947 to December, 1958. He is a member of AIChE, ACS, and the Combustion Institute.


CRUDE STOCKS
(Millions of Barrels End of Month)
CRUDE RUNS TO STILLS
(Thousands of Barrels Daily)
GASOLINE STOCKS
(Millions of Barrels End of Month)
1958
1959
DISTILLATE FUEL STOCKS
(Millions of Barrels End of Month)
RESIDUAL FUEL STOCKS
(Millions of Barrels End of Month)
KEROSINE STOCKS
(Millions of Barrels End of Month)
Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec

Taking Stock

- Crude stocks up sharply
- Crude runs continue to rise
- All other stocks following seasonal trends

U. S. Monthly Oil Trends
(THOUSANDS OF BARRELS DAILY)

ITEM	JANUARY 1959	JANUARY 1958	JANUARY % Diff.	Dec. 1958
SUPPLY				
U.S. Crude Oil Production	7,117	6,865	+ 3.7	7,105
U.S. Natural Gas Liquids Production	830	814	+ 2.0	830
U.S. Total Imports	1,924	1,817	+ 5.9	1,935
Total Crude Oil Imports	835	1,024	—18.5	1,039
East Coast Crude Imports	681	854	—25.4	792
Total Refined Products Imports	1,089	793	+37.3	803
Total New Supply	9,871	9,496	+ 3.9	9,870
Stock Changes, All Oils (Daily)	—1,081	—807	....	—1,332
DEMAND				
Total Demand, All Oils	10,952	10,303	+ 6.3	11,202
Gasoline Demand	3,664	3,527	+ 3.9	3,786
Distillate Fuel Demand	3,191	2,748	+16.1	3,091
Residual Fuel Demand	1,960	1,873	+ 4.6	1,854
Domestic Demand, All Oils	10,672	10,064	+ 6.0	10,897
Export Demand, All Oils	280	240	+16.7	305
CRUDE RUNS				
Crude Runs at U.S. Refineries	8,190	7,672	+ 6.8	7,956
Domestic Crude Runs to Stills	7,211	6,720	+ 7.3	6,952
Foreign Crude Runs to Stills	979	952	+ 2.8	1,004

KIND OF OIL	TOTAL U.S. STOCKS Millions of Barrels End of Month JANUARY 1959	JANUARY 1958	JANUARY % Diff.	Dec. 1958	STOCKS EAST OF CALIFORNIA Millions of Barrels End of Month JANUARY 1959	JANUARY 1958	JANUARY % Diff.	Dec. 1958
Crude Oil	259.7	284.5	— 8.7	262.9	220.9	241.3	— 8.5	223.6
Gasoline	198.0	207.1	— 4.4	186.2	171.5	178.3	— 3.8	160.8
Distillate Fuel Oil	95.4	122.4	—22.1	126.7	83.8	107.3	—21.9	114.1
Residual Fuel Oil	57.3	57.6	— 0.5	60.7	27.5	30.3	— 9.3	28.5
Kerosine	20.8	23.1	—10.0	26.1	20.5	22.7	— 9.7	25.7

Source: Except for latest two months, all data from U.S. Bureau of Mines. Data for last two months from American Petroleum Institute weekly reports and U.S. Bureau of Mines weekly crude stock report; except U.S. Natural Gas Liquids Production and Demand figures which are from WORLD OIL.

How to cut costs in . . .

Mechanical Drive Steam Turbine Application

The principle is old—conversion of heat to mechanical energy. But, using these new ideas on selection can give you lower initial and fuel costs

Stanley Styrna
General Electric Company
Fitchburg, Mass.

MECHANICAL DRIVE steam turbines have been used widely in the refining and petrochemical industries for many years. Usually the application is for driving compressors, however, they have also been used to drive fans, pumps and other equipment. In recent years, horsepower ratings of these turbines has increased markedly, to match the steadily increasing demands of the driven equipment. Ratings of 5,000 hp are very common, and the trend is still upward. When turbines of such large horsepower are used, care in selecting steam conditions, speed, efficiency, and operating conditions, can result in substantial savings in turbine initial costs and fuel costs. This is so because these factors are influential in affecting a turbine's size, construction details, design details, choice of materials and steam consumption.

Continually rising fuel costs require that the users of mechanical drive turbines put greater emphasis on steam consumption. In many of the refining and petrochemical industries there are process steam requirements which are served in part by noncondensing turbines. Frequently these plants have a variety of steam conditions and requirements, and condensing turbine drives could be selected at a saving in cost and still achieve the desired overall plant and process heat balance.

This article presents data which show how costs can be reduced by applying a turbine more economically for a given application. It shows how combined turbine initial costs and fuel costs vary over a range of steam conditions, speeds and ratings. The most economical steam conditions and speed may be approximated from these data. This article also tells how costs can be reduced by properly specifying a turbine's efficiency level and its normal operating point. It should be noted that only turbine costs of condensing turbines have been considered. The cost of the driven equipment, boiler piping and condenser were not included; but, will also be factors to consider in selecting steam conditions and speed.

The cost of purchasing and operating mechanical drive steam turbines can best be reduced when such items as steam conditions, speed, efficiency level, and operating point are being selected. After these items are selected, the initial cost of the turbine and the fuel costs for the life of the turbine will have been determined. It is therefore desirable that these items are selected only after consideration has been given to their effect on initial turbine costs and fuel costs.

To assist users of turbines in selecting the most economical steam conditions and speed, calculations have been made which show how combined initial turbine costs, and operating costs, vary over a range of steam conditions and speed. The results of these calculations have been plotted on Figures 1 through 5. These costs were calculated using data for turbine selling price and efficiency which are representative of industry at the present time. From these curves can be calculated the combined costs of purchasing a mechanical drive turbine and operating it full load for a period of three years, for 90 percent of the total available time. Fuel costs are assumed to be 25 cents per million Btu and boiler efficiency of 85 percent. The charts may therefore be used to help in selecting the most economical steam conditions and turbine speed, provided that operating periods and fuel costs are as indicated in Figure 1.

Figure 1 shows a plot of investment cost plus operating costs divided by horsepower (dollars/horsepower)

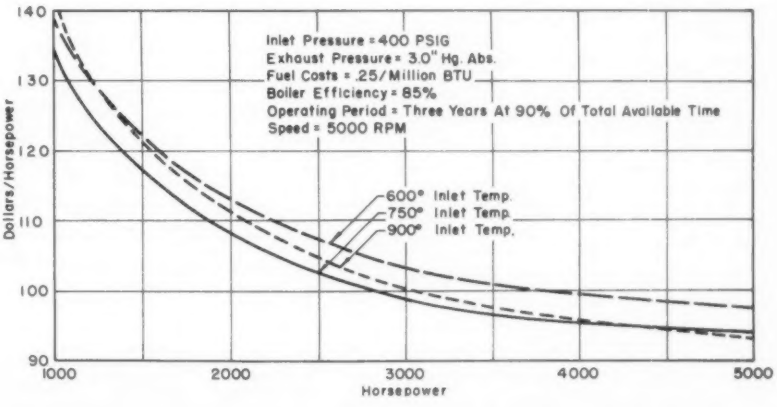


FIGURE 1—Initial investment and operating dollars per horsepower vs turbine horsepower rating at conditions shown in the box.

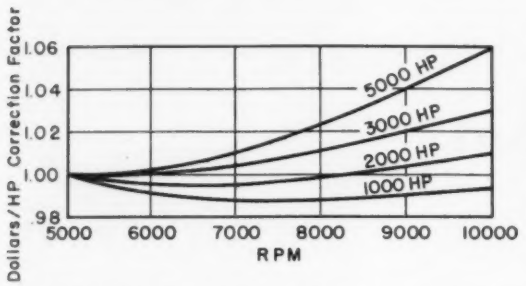


FIGURE 2—Dollars per hp factor corrects speed.

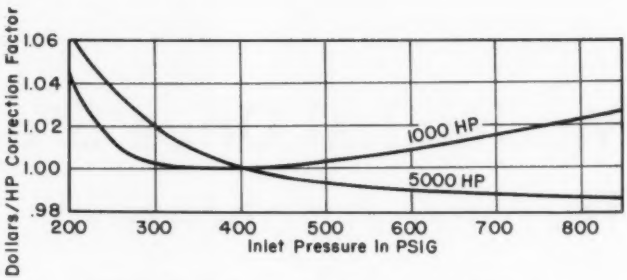


FIGURE 3—Dollars per hp factor corrects inlet pressure.

versus horsepower rating, when steam conditions, operating period, and fuel costs are as indicated. It should be noted that Figure 1 can be used to obtain the most economical turbine inlet temperature and that below ratings of 4000 hp this will usually be 750 F. Since the curves on Figure 1 are based on only one inlet pressure (400 psig) and one speed (5,000 rpm), Figures 2 and 3 have been prepared so that combined investment and fuel costs can be obtained for other inlet pressures and speeds.

From Figure 2 a dollars per horsepower correction factor for speed may be found. When this factor is multiplied by the dollars per horsepower obtained from Figure 1, the combined investment costs and operating costs for speed other than 5,000 rpm has been calculated.

For inlet pressures other than 400 psig, combined costs in dollars per horsepower can be calculated, by multiplying the result obtained from Figures 1 and 2 with the correction factor obtained from Figure 3.

If the condensing exhaust pressure is 2.0 in Hg. abs. or 4.0 in Hg. abs., multiply the results from Figures 1, 2, and 3 by the dollars per horsepower correction factor obtained from Figure 4.

Combined initial turbine costs and operating costs in dollars can now be obtained by multiplying the corrected dollars per horsepower from Figures 1, 2, 3 and 4 by the horsepower rating of the turbine.

When fuel costs and operating periods are appreciably different from those shown in Figure 1, combined costs in dollars per horsepower can be computed with the aid of Figure 5. On the chart is plotted a ratio of operating costs over combined operating costs and investment costs, when the operating period is three years and fuel costs are 25 cents per 1 million Btu. With this ratio, operating costs may be separated from investment costs.

This can be done by first calculating the dollars per horsepower from Figures 1, 2, 3, and 4. Then, from Figure 5, read the ratio of operating costs over operating costs plus investment costs for the proper speed and inlet temperature. When this ratio is multiplied by the dollars per horsepower, calculated from Figures 1, 2, 3 and 4, operating costs are obtained thereby separating operating costs from investment costs. Operating costs can now be adjusted, since they will vary directly as the fuel costs per 1 million Btu and the length of the operating period.

For example, if fuel costs are 50 cents per 1 million Btu instead of 25 cents, and the operating period is four years instead of three, operating costs can be adjusted by multiplying by two and four thirds. By adding the adjusted operating costs to the investment costs, a corrected value of dollars per horsepower has been obtained.

In the above case it will be observed that the operating cost varies directly as the fuel cost. This is an approximation based on the assumption that the fuel cost is by far the major share of the operating cost. Maintenance, attendance and other costs are not included in these studies.

The following examples illustrate the use of Figures 1 through 5.

Example 1. Determine the combined investment and operating costs of a 5,000 hp mechanical-drive turbine when steam conditions are 200 psig, 600 F, 2.0 in abs. and the turbine speed is 10,000 rpm. Fuel costs are 50 cents per 1 million Btu, the operating period is five years for 90 percent of the total available time, and the boiler efficiency is 85 percent. From Figures 1, 2, 3, and 4:

$$\text{Dollars/Horsepower} = 97.5 \times 1.06 \times 1.063 \times 1.018 = 111.7$$

From Figure 5:

$$\frac{\text{operating costs}}{\text{Operating costs} + \text{investment costs}} = .80$$

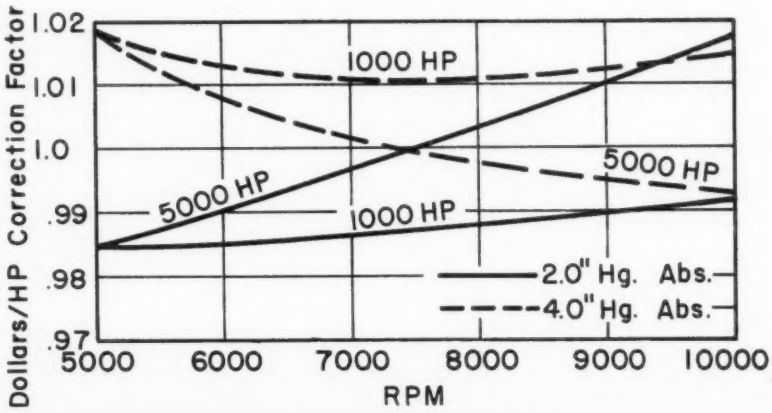


FIGURE 4—Dollars per hp factor corrects exhaust pressure.

Operating costs = $.80 \times 111.7 = 89.2$

Investment costs = $111.7 - 89.2 = 22.5$

Corrected operating costs =

$$89.2 \times \frac{50}{25} \times \frac{5}{3} = 298.0$$

Corrected dollars/horsepower =

$$298.0 + 22.5 = 320.5$$

Combined investment and operating costs =

$$320.5 \times 5000 = \$1{,}602{,}500$$

Example 2. Calculate the combined investment and operating costs for the example above, if the steam conditions are 400 psig, 750 F., 3.0 in. abs., turbine speed is 8,000 rpm and all other conditions the same.

Dollars/horsepower =

$$94.0 \times 1.023 \times 1.00 \times 1.0 = 96.4$$

$$\frac{\text{operating costs}}{\text{Operating costs + investment costs}} = .779$$

Operating costs = $.779 \times 96.4 = 75.0$

Investment costs = $96.4 - 75.0 = 21.4$

Corrected operating costs =

$$75.0 \times \frac{50}{25} \times \frac{5}{3} = 250.00$$

Corrected dollars/horsepower =

$$250.0 + 21.4 = 271.4$$

Combined investment and operating costs =

$$271.4 \times 5000 = \$1{,}357{,}000$$

From the above example it can be seen that a change in steam conditions and speed resulted in a saving in combined investment and operating costs of $245,500.

It should be noted from Figure 5 that operating costs exceed investment costs even in the low ratings. Operating costs can become as high as 80 percent of the combined costs at ratings of 5,000 hp. This further illustrates the necessity of carefully selecting those items which affect operating cost. After the selection of steam conditions and speed, the next item to consider toward reducing operating costs is the turbine efficiency. A turbine efficiency level which is representative of the industry for mechanical drive turbines is shown on Figure 6. This efficiency level is the basis of the cost data appearing in Figures 1 through 5.

Turbines with efficiencies higher than that shown on Figure 6 can be built, however, the initial turbine cost will be greater. It therefore becomes a question of whether the reduced operating cost of a turbine with an improved efficiency will offset the higher turbine selling price. When purchasing a mechanical drive turbine, it is therefore desirable to investigate whether turbines with improved efficiency will justify the added initial cost. An indication of the saving obtained in operating dollars, from an improvement of a few points in efficiency, can be obtained from the following example.

Example 3. Assume that for the case illustrated in Example 1, a turbine could be purchased for an additional $10,000 which has an improved efficiency of 4.0 percent. Will the additional $10,000 in selling price justify the improved efficiency of 4.0 percent?

Corrected operating costs from Example 1 = 298.0 dollars/horsepower

A 4.0 percent improvement in efficiency will reduce operating costs by:

$298.0 \times .04 = 11.92$ dollars/horsepower

Saving in operating costs =

$$11.92 \times 5000 = \$59{,}600$$

Net Saving =

$$\$59{,}600 - \$10{,}000 = \$49{,}600$$

It can be seen that the net saving of $49,600 will justify the additional $10,000 in the selling price of a turbine, which has an improved efficiency of 4.0 percent.

From the above example, it should be noted, that the turbine rating will greatly influence the saving in operating costs that result from improvement in turbine efficiency. As turbine ratings increase above 5,000 hp, differences in turbine efficiency of as little as 1.0 or 2.0 percent may justify the added initial cost of turbines with improved efficiency.

Operating costs can be further reduced if particular attention is given to specifying the normal operation point of the turbine. A multi-stage turbine can be designed for "best efficiency" at only one set of steam conditions, one speed, and one horsepower; and this then becomes known as the design point. When a turbine operates at other than its "design point," operation occurs at reduced efficiency. This is illustrated in Figure 7.

For the rated inlet pressure, temperature, exhaust pressure and speed, the design point would have the highest efficiency. The difference in steam flow between Curve *A* and the line of constant efficiency is the reduction in turbine efficiency when operating at other horsepowers than the rated horsepower.

If the turbine is operated at 10 percent off the design speed, turbine efficiency will again suffer. This is illustrated by Curve *B*.

Many times, turbine specifications require that the turbine have capacity for rated horsepower at reduced inlet pressure and higher than rated exhaust pressure. This requirement for operation at minimum steam conditions is also detrimental to turbine efficiency. The increased steam flow for operating at minimum steam conditions and ten percent off design speed is shown on Curve *C*.

Curves *A*, *B*, and *C*, illustrate that turbine costs can be reduced if:

- The turbines design point and the normal operating point are the same.
- Design rpm and normal operating rpm are the same.
- Requirements for rated horse-

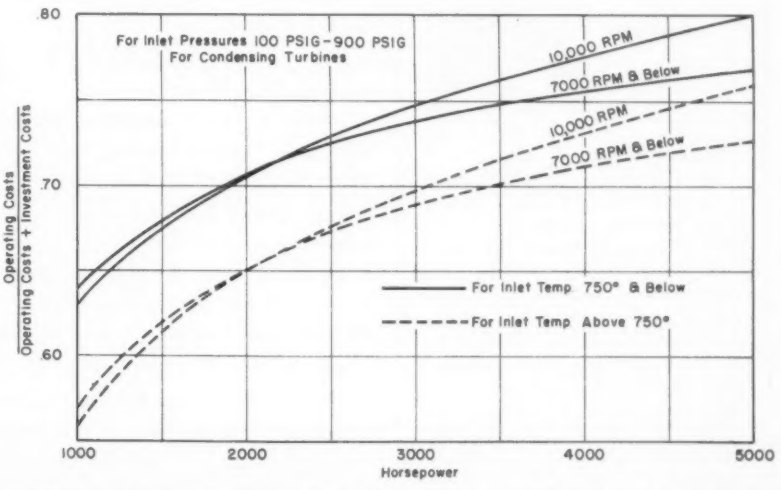
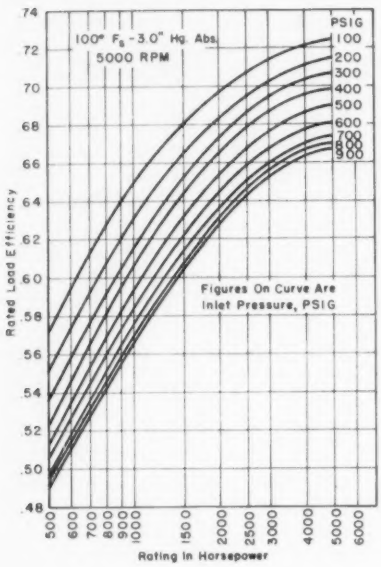


FIGURE 5—Operating costs can be found when this factor is multiplied by dollars per hp from Figures 1 through 4.



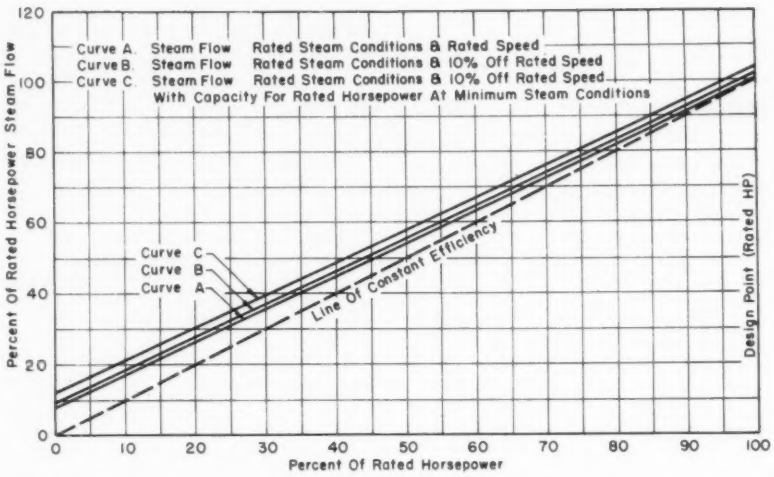

Curve A. Steam Flow Rated Steam Conditions & Rated Speed
Curve B. Steam Flow Rated Steam Conditions & 10% Off Rated Speed
Curve C. Steam Flow Rated Steam Conditions & 10% Off Rated Speed
With Capacity For Rated Horsepower At Minimum Steam Conditions
Curve C
Curve B
Curve A
Line Of Constant Efficiency
Design Point (Rated HP)
Percent Of Rated Horsepower Steam Flow
Percent Of Rated Horsepower

FIGURE 6 (left)—Typical efficiencies for mechanical drive turbines made today.

FIGURE 7—When a turbine operates at other than its "design point," operation occurs at reduced efficiency.

power capacity at reduced inlet pressure and higher than rated exhaust pressure are eliminated.

About the Author

Stanley Styrna is manager of product design in General Electric Co.'s Small Steam Turbine department, Fitchburg, Mass. He supervises the personnel and design work done in the Product Design subsection. Styrna received a B.S. degree in mechanical engineering from the University of New Hampshire. He has worked as a power engineer, thermodynamic engineer and design supervisor, and has been manager of product design for 17 months. He has authored a number of published articles.

After the most economical steam conditions, speed, efficiency level, and design point have been selected, and the turbine has been placed in service, it is desirable that turbine efficiency is checked periodically. High turbine efficiencies are obtained by designing nozzles and bucket vanes of the proper shape. It is also necessary for good efficiency, that the surfaces of these nozzles and bucket vanes have very smooth finishes.

The properly designed shapes of the nozzles and bucket vanes can, however, become damaged, should foreign material pass through the turbine. Nozzles and vanes can lose their smooth surface finishes, if fouling occurs from deposits left by the steam. If either or both of these conditions occur, the loss in turbine efficiency and subsequent increase in steam flow can be as high as twenty percent.

The use of an accurate flow meter to check steam flow is the most simple method to check turbine efficiency. If the horsepower is known and the actual steam conditions are as stated in the specifications, a test curve of steam flow versus horsepower can be made. When this test curve of steam flow is checked against the steam flow guaranteed by the turbine manufacturer, it can be seen whether the turbine is operating at its design efficiency. Subsequent periodic tests will indicate whether a deterioration of turbine efficiency has occurred due to foreign material damage or by deposits on the nozzles and bucket vanes.

It is beyond the scope of this article to describe in detail how the above mentioned test data should be taken, particularly in regard to location and type of instrumentation. Reliable methods of testing can be obtained from the A.S.M.E. Test Codes, or from the recommendations of the turbine manufacturer.

Note: When this paper was written the author included information and expressed opinions believed to be correct and reliable. Because of the constant advance of technical knowledge, the widely differing conditions of possible specific application, and the possibility of misapplication, any application of the contents of this paper must be at the sole discretion and responsibility of the user.

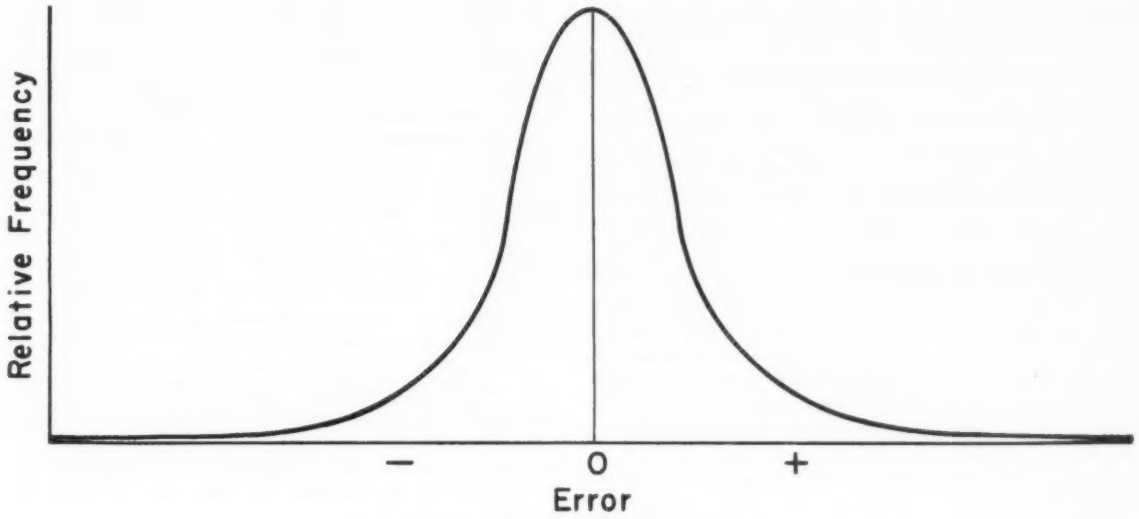


FIGURE 1—The distribution of random errors.

How Good Is the Answer You Report?

PART 1—What are the Confidence Limits?

Part 2—How does it compare with others?

R. S. Schechter and E. H. Wissler
The University of Texas, Austin

WHEN DATA ARE accumulated, their results often are summarized by statements like the following: "Conversion using the new cracking catalyst was 32.4 Wt. %." A look at the individual results, however, might cause one to wonder whether the conversion could have been 31.9 or 33.3 Wt. %.

Due to the inevitable scatter of experimental data, the reported conversion must be viewed as only an estimate of the expected conversion, that is, it is the conversion about which we would expect the measured values to cluster. To define the experimental results more completely, an indication of the dispersion of the results should also be reported. How can the reliability of the estimated conversion be determined, and how should it be reported?

Some basic statistical methods which are useful in the analysis of engineering data will be described here. Included are some simplified techniques which can be used without appreciable loss of information when the sample contains ten or fewer observations.

To demonstrate the methods of calculation, some pertinent data have been taken from the literature. The data in Table 1 were obtained by Whitaker and Kinzer[7] who performed seven replicate experiments while studying the effect of residual coke on cracking catalyst performance.

Why Are the Results Scattered? Ideally, each of the entries in Table 1 should be identical, but errors cause dispersion or scatter in the data. In general, there are three types of errors.[6] An isolated, large error caused by carelessness is called a *blunder*. An error which can be attributed to a faulty calibration or a poor standardization is called a systematic error, and it contributes to the *loss of accuracy*. Poor reproducibiliy or *lack of precision* is caused by random or accidental errors which cannot be attributed to a single cause. The methods of this article apply only to random errors.

Usually the occurance of a small random error is more probable than the occurance of a large error. If the relative frequency of occurance of random errors of a given magnitude is plotted against the magnitude of the error for a large number of observations, a bell-shaped curve similar to the one in Figure 1 is obtained.

This distribution is the normal or Gaussian distribution. Although the properties of this distribution have

How Good Is the Answer You Report?

been developed by statisticians, they will not be included in this article. The interested reader can find this material in any standard statistics book. The methods which are discussed here are all based on the assumption that the errors are normally distributed. In the absence of a sound reason for believing otherwise, such as a definite lack of symmetry in the data, one can usually assume that his data are distributed normally.

Which Answer is Correct? Assuming that only random errors and not systematic errors are present, how does one determine the best estimate of the expected conversion? This is one of the principal problems of statistics, and it can be shown that the best estimate is the mean of the individual observations. Indeed, as the number of observations becomes very large, the mean approaches the expected value.

Hence, the best estimate of the expected value is defined by the following equation:

$$\bar{x} = \frac{1}{n} \sum_{i=1}^{n} x_i$$

where

$\bar{x}$ = mean value
x_i = the value of an individual measurement
n = number of measurements

For the data of Table 1, the mean value is

$$\bar{x} = (32.8 + 31.9 + 32.0 + 32.5 + 32.3 + 32.9 + 32.5)/7 = 32.4$$

Although this is the value that is normally used to estimate the true value, the median may yield a better estimate if the number of observations is small and blunders are present.[3] If the data are arranged in order of increasing values, the median is the central value of an odd number of observations or the average of the two central values of an even number of observations. It is obvious that a blunder or extraneous value does not affect the median as much as the mean. When the data of Table 1 are arranged in increasing order as in Table 2, the median is seen to be 32.5, which compares well with the mean of 32.4.

TABLE 1—Catalytic Cracking Data

Run No.	Conversion, Weight Percent
1	32.8
2	31.9
3	32.0
4	32.5
5	32.3
6	32.9
7	32.5

Note: Abstracted from Reference 7.

TABLE 2—Results in Ascending Order

Rank	Conversion, Weight Percent
1	31.9
2	32.0
3	32.3
4 (Median)	**32.5**
5	32.5
6	32.8
7	32.9

If there are no extraneous values in a small number of observations the midrange may be used to estimate the expected value. The midrange, which is simply the average of the largest and smallest observations, is more easily calculated than the mean. For the data of Table 1, the midrange is $(31.9 + 32.9)/2 = 32.4$. In this particular case, the midrange is identical to the mean.

The use of the median or the midrange rather than the mean are two of the short-cut procedures that can be employed with small loss of efficiency when the number of observations is small. In these methods the efficiency is measured relative to the mean, and it is approximately equal to the ratio of the sample size required to obtain a given precision in the estimate when using the mean to the sample size required to obtain the same precision when using the median (or midrange). Since the median of 5 observations has an efficiency of 0.68, it supplies roughly the same information as the mean of 5(0.68) or 3 observations. The efficiencies for the median and midrange are given in Table 3.

How Scattered Are the Data? Just as the mean, median or midrange characterizes the central tendency of the data, a single number may be used to characterize the dispersion. Obviously two sets of data having equal means may have quite different dispersions; and, hence, the two characteristics are independent.

The most common measure of the dispersion is the standard deviation. For a sample containing n observations, the best estimate, s, of the standard deviation is computed from the formula:

$$s = \sqrt{\sum_{i=1}^{n} \frac{(x_i - \bar{x})^2}{n-1}}$$

$$= \sqrt{\sum_{i=1}^{n} \frac{x_i^2 - n\bar{x}^2}{n-1}}$$

The second formula is more convenient to use than the first because both $\sum_{i=1}^{n} x_i^2$ and $\sum_{i=1}^{n} x_i = n\bar{x}$ can be obtained on a desk calculator in one series of multiplications. For the data of Table 1,

$$\sum_{i=1}^{n} x_i^2 = (32.8)^2 + (31.9)^2 + (32.0)^2 + (32.5)^2 + (32.3)^2 + (32.9)^2 + (32.5)^2 = 7355.65$$

and

$$s = \sqrt{\frac{7{,}355.65 - 7(32.414)^2}{7-1}} = 0.40$$

TABLE 3—Efficiencies of The Median and Midrange

Sample Size	EFFICIENCY	
	Median	Midrange
2	1.00	1.00
3	0.74	0.92
4	0.84	0.84
5	0.69	0.77
6	0.78	0.71
7	0.67	0.65
8	0.74	0.61
9	0.65	0.57
10	0.71	0.54

Note: Taken from information in Reference 4.

TABLE 4—Factors for Estimating the Standard Deviation from the Range

Sample Size	K_w	Efficiency
2	0.89	1.00
3	0.59	0.99
4	0.49	0.98
5	0.43	0.96
6	0.40	0.93
7	0.37	0.91
8	0.35	0.89
9	0.34	0.87
10	0.33	0.85

Note: Taken from information in Reference 4.

TABLE 5—Confidence Factors for 95 Percent Confidence Level

Sample Size	Student's t	τ_w
2	12.7	6.4
3	4.3	1.3
4	3.2	0.72
5	2.8	0.51
6	2.6	0.40
7	2.5	0.33
8	2.4	0.29
9	2.3	0.26
10	2.3	0.23

Note: Taken from information in Reference 4.

Another measure of the dispersion is the range, the difference between the largest and smallest observations. The range is a biased estimate of the standard deviation, but an unbiased estimate, s_w, can be obtained by multiplying the range, w, by the value, K_w, given in Table 4.

$$s_w = wk_w$$

The efficiency of the standard deviation estimated from the range as compared to that estimated by the sum of the squares of the differences from the mean is also given in Table 4.

For the data of Table 1,

$$w = 32.9 - 31.9 = 1.0$$
$$K_w = 0.37 \text{ for 7 observations}$$
$$s_w = 1.0\ (0.37) = 0.37.$$

The value of 0.37 just calculated s_w agrees well with the value 0.40 previously calculated for s.

What Are Confidence Limits? Although the standard deviation characterizes the dispersion of the data, the use of confidence limits provides a clearer picture. These limits calculated from the standard deviation define an interval within which the expected value lies with a specified probability, usually 95 percent. If confidence limits are calculated for each of a large number of samples containing n observations each and drawn from a population having an expected value, μ, then 95 percent of the confidence intervals will contain μ.

The confidence interval[2] is:

$$\bar{x} \pm \frac{t\,s}{\sqrt{n}}$$

where n = number of observations in the sample
t = Student's t (Table 5)

Values of t for other confidence levels can be found in any statistics text.

For the data of Table 1, the confidence limits at the 95 percent confidence level are

$$32.4 \pm \frac{2.5\ (0.4)}{\sqrt{7}} = 32.4 \pm 0.4 \text{ Wt. \%}$$

Hence, there is a 95 percent probability that the expected conversion lies between 32.0 Wt. % and 32.8 Wt. %.

A short-cut method for determining the confidence interval uses the mean and the range. Using this method the confidence interval is

$$\bar{x} \pm \tau_w w$$

where τ_w is also tabulated in Table 5.

For the data of Table 1, the short-cut method gives confidence limits at the 95 percent level of

$$32.4 \pm 0.33\ (1.0) = 32.4 \pm 0.3 \text{ Wt. \%}.$$

Actually the limits were ± 0.38 Wt. % using the standard deviation and ± 0.33 using the range, so that agreement between the two methods is satisfactory.

The loss of information in applying the short-cut techniques will in many cases be compensated by the rapidity and simplicity of the calculations. Proschan and Babcoch[5] have presented other examples of these useful techniques.

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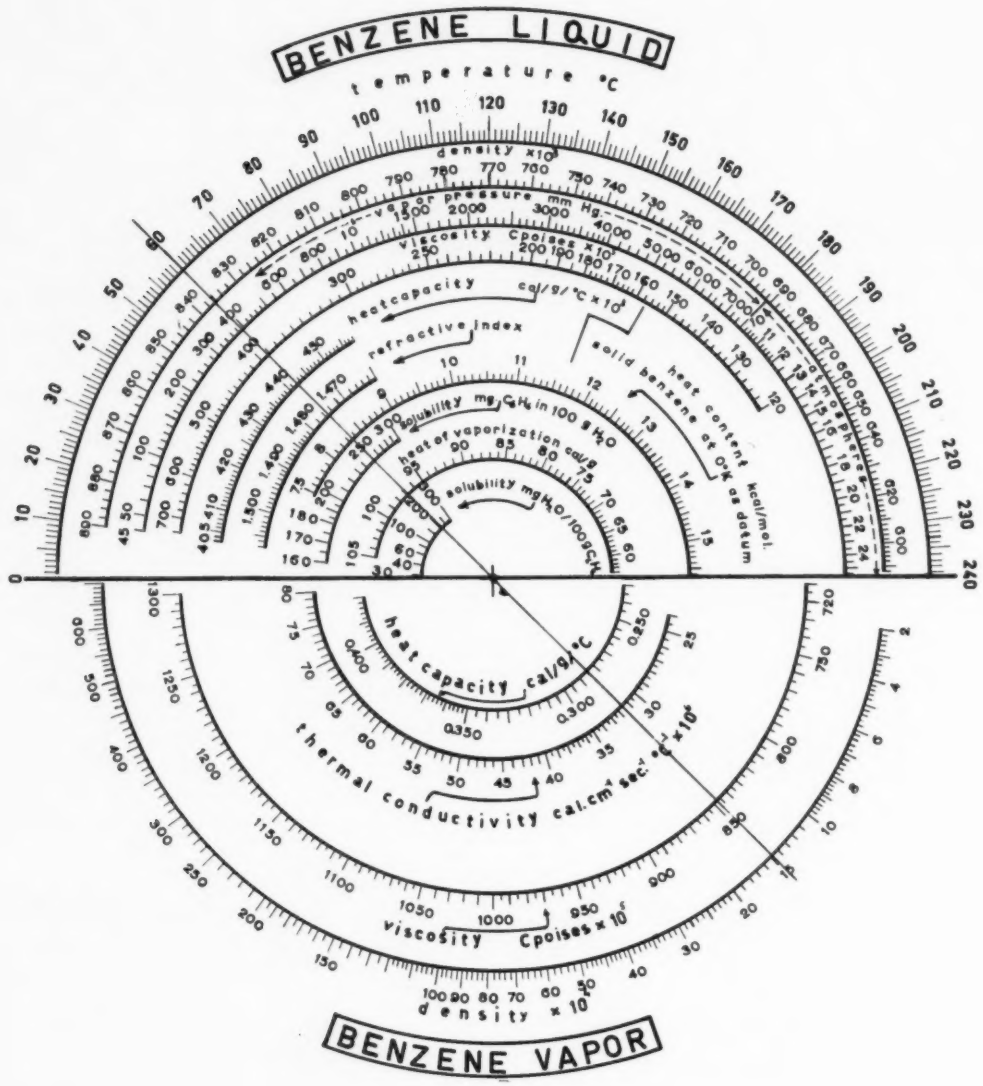
Find Benzene Properties by Nomograph



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SEVERAL PHYSICAL properties of benzene liquid and vapor have been combined in a single nomogram,[1] which replaces as many graphs as the scales used. The same temperature scale holds for the liquid and the vapor.

The nomogram is used as follows: Any line passing through the center intersects the scales in corresponding points, e.g. the line drawn on the nomogram indicates that at 60 C liquid benzene has the following properties (the values in parenthesis are literature values): density = 0.8364 (0.8357); vapor pressure = 390 mm Hg (389); viscosity = 392 × 10^{-3} Cpoises (393); heat capacity = 0.442 cal/g/C (0.442); refractive index = 1.4752 (1.4746); heat content = 8.35 kcal/mol (8.358); solubility = 250 mg benzene in 100 g of water (250) and 210 mg water in 100 g of benzene (250).

For the vapor at 60 C: heat capacity = 0.285 cal/g/C; thermal conductivity = 31.5 cal/cm/sec C (31.8 × 10^{-6}); viscosity = 847 × 10^{-6} Cpoises (849); density = 0.00148 (0.0015).

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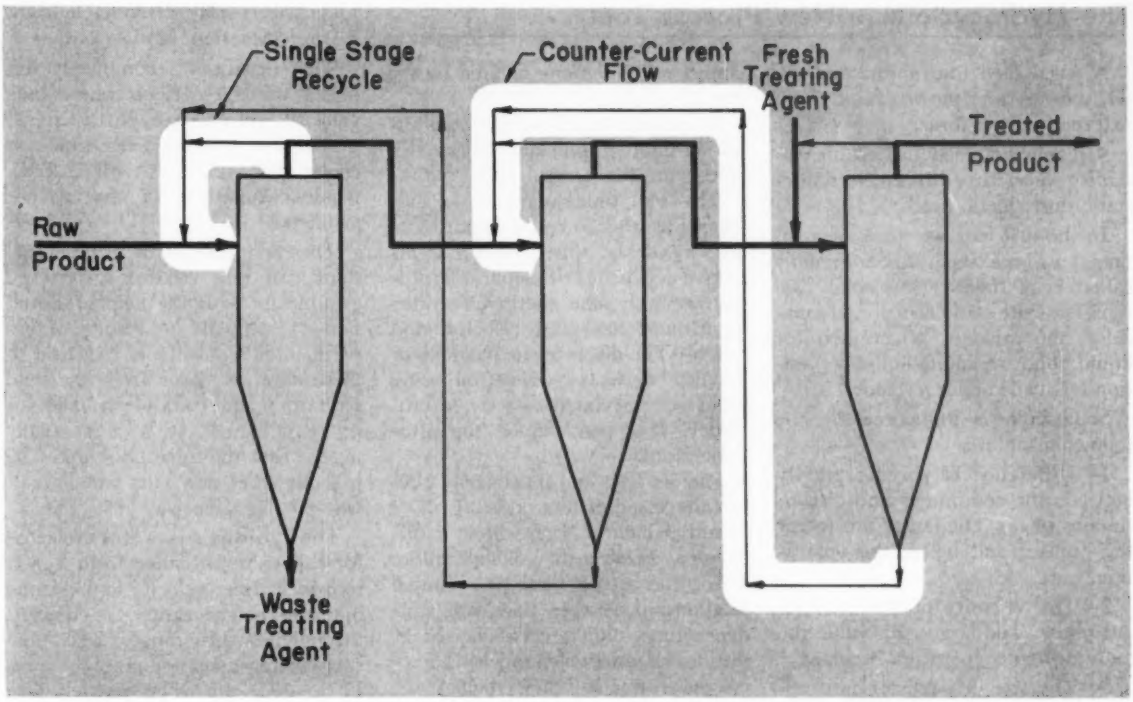

FIGURE 1—One use for the hydrocyclone system is as a counter-current multi-stage treater with low hold-up.

The Hydrocyclone, a New Process Tool

The hydrocyclone uses centrifugal acceleration to hasten liquid-liquid or liquid-solid mixing and separation. Here are some of the factors which influence the speed and degree of operation

Fred Sager
London

BASED ON design principles and practical examples, the hydrocyclone represents a highly versatile and simple process tool for achieving separation. It is applicable to a wide variety of process conditions and operates with minimum hold-up. Installation and maintenance considerations are the same as those governing piping items. Depending on process requirements, the hydrocyclone can be used for total or partial separation either alone or in conjunction with any conventional apparatus.

Factors Affecting Separation. Acceleration due to gravity g, is the cause of settling of two heterogenous phases of different specific gravity. Centrifugal acceleration, a multiple of g, is the cause of centrifugal separation.

Centrifugal acceleration is generated by rotation.

The ratio between centrifugal and gravity acceleration is given by:

$$z = (6.22 \times 10^{-2})(v^2)/D$$
$$\text{or} \quad = (1.70 \times 10^{-4})(N^2)(D) \quad (1)$$

where v = tangential velocity, ft/sec
D = diameter of rotation, ft
N = rate of rotation, rpm

Rotation can be achieved in two radically different ways:

• Axial feed into a rotating vessel, power for the rotation from external driving force.

• Tangential feed into a static vessel. Rotation caused by conversion of static into kinetic head.

In the first case we speak of a rotary centrifugal separator, commonly called centrifuge. The second case represents the static centrifugal separator, the cyclone. When used for liquid/solid or liquid/liquid separation it is called hydrocyclone.

Separation is influenced by the following factors:

1—Difference of specific gravity between the continuous and discontinuous phase. The larger this factor the quicker and better the separation.

2—The viscosity of the continuous phase. The larger this value the more difficult separation becomes.

3—The size of particles or droplets (discontinuous phase) and implicitly the surface tension of the droplets. The larger the particles or droplets, the easier their removal.

4—Secondary currents, often called eddy currents. They may be the cause of entrainment and also of shearing forces. In settlers their sources may be temperature gradient and channelling. In centrifuges they are caused by the impact of rotating internals on the droplets, as well as change of direction of flow and centrifugal acceleration.

In a cyclone the flow is three-dimensional and may be resolved at a point P into three components, i.e. tangential, radial and axial. Kelsall[1] has measured tangential and vertical velocity components in a small hydrocyclone and presented the results as tangential, vertical and radial velocity profiles, from which a picture of the flow pattern can be obtained. Van Dongen and Ter Linden[2] have shown secondary streamlines and variation of static and total (static + dynamic) pressure at different points inside a cyclone of conventional shape. Undesirable currents may be caused at the junction of cylindrical and conical section,[3] in the headroom above the inlet pipe,[4] or outside or just under the vortex finder.[1]

In a well designed cyclone their effect should be negligibly small compared to the one created by the double spiral.

Stairmand[3] has illustrated this situation photographically, using a dye tracer for the central core.

5 a—The time a system is subjected to the force of separation, the "residence time," which is effective volume of separator/flow rate per unit time, the inverse value expressing the space velocity, and

5 b—The distance the particles or droplets must travel before being separated is related directly to efficiency. It depends upon separator dimensions.

Factors 1, 2, and 3 primarily govern the speed of separation. Factors 4 and 5 have a more direct influence on the efficiency of separation.

For the settler there is a simple relationship between flow rate, residence time, and effective height of settling channel or channels, the acceleration due to gravity being constant.

For centrifuges the relationship of flow rate, residence time and overall dimensions follow the same pattern but with acceleration due to gravity replaced by its multiple z from Equation (1).

This situation is completely different for the cyclone where inlet velocity (flow rate/inlet area) makes flow rate, residence time and centrifugal acceleration interdependent functions of the cyclone geometry.

The relationship of these functions can best be demonstrated graphically with the help of Equation (1) applied to results of experimental separations.[5] Although these data are taken from gas/solid separation, the example is valid for hydrcyclones, as it is generally agreed that the same laws hold true in both cases and cuts can be calculated the same way.

The cyclone diameters selected for this example range from 2-inch to 8-inch. Inlet velocity and cyclone diameter/height ratio are constant throughout this range. The flow rates increase correspondingly from 12 to 175 cfm. The particle size specific gravity is constant at 1.0. "Cut size" is defined as the diameter of those particles which the cyclone will collect to the extent of 50 percent. In the upper portion of Figure 2 the cut sizes are plotted versus the cyclone diameter. The flow rate shown as a second abscissa is the air handling capacity of the given size cyclone. The calculated values of z, space velocity, and residence time are shown as separate curves. The units of space velocity and residence time are arbitrary and are intended only to show the magnitude of the changes.

For the varying cyclone sizes the inlet velocities which are required to induce a centrifugal acceleration equal to the value corresponding to the 2-inch cyclone are then calculated and plotted in the lower portion of Figure 2. With the help of velocity correction factors[5] the corresponding cut sizes are determined and shown as a dashed line in Figure 2.

Although the results of separation which thus can be anticipated are better throughout, the influence of space velocity is evident. To obtain the same results for a given throughput the volume ratio for a steeler, a centrifuge and a hydrocyclone were in a test case 20,000:100:1, respectively.

THE POSSIBILITIES of the hydrocyclone in coal preparation have been demonstrated as early as 1939.[16] In the years following the war further work on this subject has been published, now including also recovery of coal fines[17,18] and reclaiming of water,[19] with the aim of making closed cycle operation possible. In connection herewith design variables of the hydrocyclone have been systematically investigated.[20,21,22]

Following up on the principles outlined in a number of patents,[23] excellent results are reported to to have been obtained in the food industry, and in particular of the separation of potato starch.[24] The success, it is stated, is due to the special properties of the cyclone which gives it a fundamental advantage over other apparatus.

In the field of atomic energy the hydrocyclone has proved its operability for continuous removal of homogeneous reactor fission products.[25,32]

Experiments carried out to test potentialities of the hydrocyclone to remove solids from drilling fluids were found very encouraging for both the removal of drilled solids and recovery of barite.[29]

The diameter of the largest particle that cannot be caught in a cyclone or, differently expressed, that will neither move inwards nor outwards, can be calculated by considering it being in equilibrium between an outward acting centrifugal force and an inward acting viscous drag force. Basing the latter on on Stokes' law, introducing flow rate into the expression of radial velocity, substituting inlet velocity times inlet area for flow rate and using volumetric expression for mass m in the equation for centrifugal force, the theoretical minimum particle diameter d for tangential velocity equal to inlet velocity is

$$d = \sqrt{\frac{9\mu D_i^2}{4\,h\,v\,(\rho - \rho')}} \qquad (2)$$

μ — absolute viscosity
D_i — diameter of equivalent circular inflow
h — height of cyclone
v — inlet velocity
ρ — specific gravity of heavy component
ρ' — specific gravity of light component

In practice, definition of cyclone efficiency varies according to its application. When each of the separated components is expected to contain as little as possible of the other, the separation number, $E = \frac{A_1}{A} - \frac{B_1}{B}$, is a simple and useful criterion for a mixture of two liquids with flow rates A and B at the inlet and A_1 and B_1 at the overflow.[6] At complete separation A_1 = A and $B_1 = 0$ and therefore $E = 1$.

Achievements and Limitations of the Centrifuge in the Petroleum Industry. For the centrifugal separation of liquid/liquid and liquid/solid systems industry had to rely in the past exclusively on contrifuges, although since the advent of catalytic cracking cyclones have become an indispensable tool for catalyst recovery from regeneration effluent gas and are successfully being used for separation of liquid entrainment from vapors.[2]

Centrifuges were reported to be used on one or several of the following considerations:

a. throughput
b. separating efficiency
c. accelerated phase separation

Typical applications for **a** and **b** in connection with refinery processes and products were water and caustic soda washing of refinery streams, crude oil desalting, purification of heavy diesel oil,[7] solvent dewaxing[8] and multi-stage counter-current extraction of lube oils. The subject of selection of centrifuge type[9] and performance evaluation[10] has been covered in detail. Applications, more specifically concerned with group **c** were sulfuric acid treatment of cracked gasoline,[11, 12] lubricating oil,[13] shale oil[14] and benzole.[15]

In order to successfully meet the growing variety of process requirements an increasing number of centrifuge types become necessary, this tendency adversely affecting cost. Flexibility requirements therefore constitute one factor limiting the use of centrifuges. Another factor is given by the limits to throughput. The largest practical centrifuge size is determined by the weight, i.e. the wall thickness required to overcome self bursting stress, with the centrifugal acceleration in the metal wall being approximately eight or more times the useful force induced for separation. On the other hand, initial-, operating- and maintenance cost are a direct function of the number of centrifuges required for a given plant throughput.

Investigation on the separation of water-in-oil emulsions[6] have led to the conclusion that due to its small dimensions and simple construction, the hydrocyclone is an attractive apparatus which, even for large throughputs, can be designed as a small unit, and therefore is of special use when high operating pressures are involved. As for settlers and centrifuges, separation is found to be impaired when viscosity effects become predominant and tangential velocities less than inlet velocity result.

The advantage obtained in treatment of petroleum hydrocarbons and similar liquids by rapid phase separation in a hydrocyclone after a controlled contact time is at the base of several patents.[26]

Investigations on mass transfer and phase equilibrium furnish a clear indication of the hydrocyclone's potentialities in connection with solvent extraction in general and for the reclaiming of industrial waste water in particular.

In this connection a series of tests has been carried out on the transfer of monobutylamine from kerosine to water.[27]

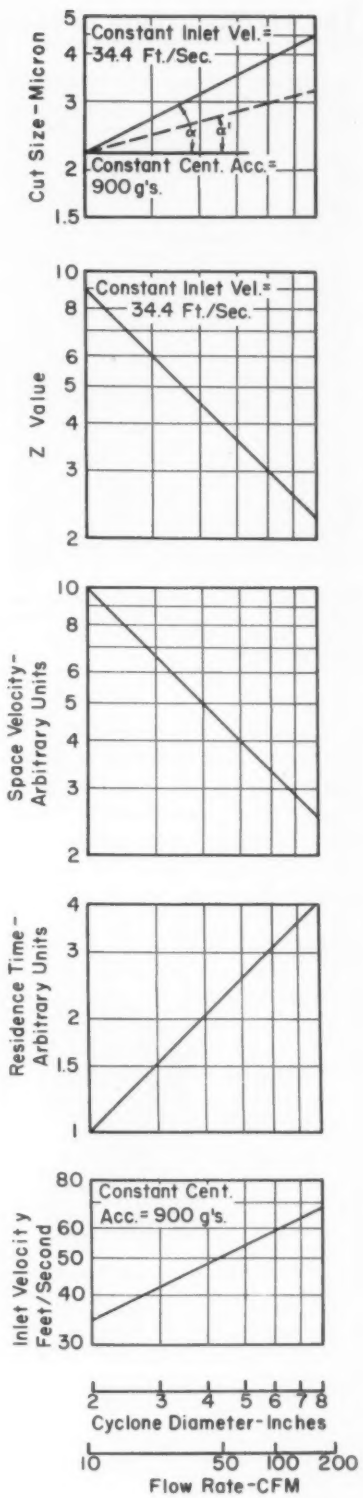

FIGURE 2—The various operating variables of the hydrocyclone can be related to the cyclone's size or to its air handling capacity.

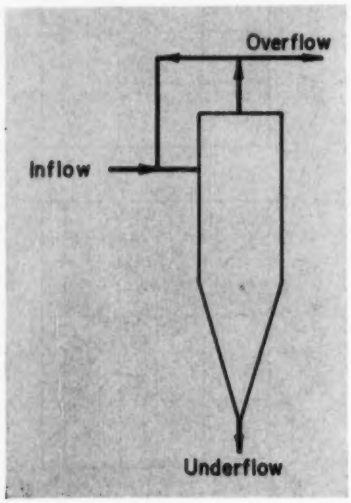

FIGURE 3—Some of the operating conditions can be controlled independently of the others through the use of the recycle principle.

Reclaiming of industrial water by extraction of phenol with isopropyl ether was carried out comparing batch-, tower-, and cyclone operation. Evidence was obtained that cyclone operation gave the best results of the three, and that it may make the difference between profit and loss.[28]

A report on the same subject published shortly after describes operation of an installation of three hydrocyclones, of 4.7-inches (120 mm) diameter each, operating in series and handling successfully an intake as large as 36 cfm (61.2 cubic meters per hour).[30] Initial cost of plant as well as operating and maintenance cost compare favorably with any other type of conventional equipment. Simplicity of operation and easy protection against corrosion and erosion are special features of the plant.

In Figure 2 it has been shown how throughput, or flow rate as it was called, coupled with cyclone dimensions determines centrifugal acceleration and space velocity, and consequently the results of separation. These conditions become controllable independently of each other through the use of the recycle principle.[31] Figure 3 shows schematically one way of recycle operation, which is best illustrated by the following practical cases:

Case 1—Centrifugal acceleration and space velocity, though interdependent, are required to be independent of plant throughput. These conditions have to be satisfied when a plant is operated below design throughput, or when circumstances make it necessary to increase the severity of separation, i.e. centrifugal acceleration and space velocity, and for practical reasons it is not possible to increase the plant throughput above normal. In the former case, an appropriate recycle will bring the cyclone flow rate back to normal, and in the latter case it will cause the required increase in separating severity.

Case 2—Centrifugal acceleration, space velocity and plant throughput are all to be independent of each other. Such conditions may, for example, be required when handling products of relatively high viscosity. In this case the tangential velocities in the cyclone tend to become less than inlet velocity and a situation may occur when increased inlet velocity creates shearing forces rather than centrifugal acceleration, with resulting splitting up of the discontinuous phase.[6]

The spinning speed of the liquid in the cyclone can be improved without increase of inlet velocity and centrifugal acceleration by increasing space velocity through recycling at a relatively larger inlet area. Interchangeable inlet connections designed with due regard to avoiding harmful secondary currents make it possible to cover a wide range of operating conditions with one cyclone.

When a treating agent is introduced into the recycle line the hydrocyclone becomes a mixing/separating unit,[31] comparable to one theoretical stage in tower operation and can be advantageously used for counter current multi-stage operation with low hold-up. Dispersion of treating agent in recycle and high space velocities particularly facilitate control of highly exothermic reactions. Temperature gradient can also be established as required. Figure 1 illustrates schematically the flow in a three stage counter treating set-up.

About the Author

Fred Sager is a native Austrian and a citizen of Sweden. He started his refining career with the Shell group in Rumania in 1926 after receiving a chemical engineering degree at Vienna Technical University. He then received a Doctor of Technical Science degree. After joining Universal Oil Products Co., Sager participated in the startup of Europe's first Dubbs cracking plant. He went with A.B. Separator Nobel in 1932—then with Kellogg International Corp. as project manager, London. He is presently a Kellogg sales representative.

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Determine Asphalt Blowing Kinetics

Reaction studies, backed up with actual plant data, indicate that asphalt air-blowing behaves like a first-order reaction

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FROM 1960 TO 1967, the demand for asphalt should average 50-percent above today's demand.[1] Yet the production of air-blown asphalt which accounts for 20 percent of all asphalt produced, still remains in the art category. With such an increase in production coming up, it seems important to get the technology of air blowing on a firmer basis.

Within limits, asphalt air blowing behaves kinetically like a first-order reaction. The reaction is partly diffusion-controlled and thus reaction-velocity constants must be corrected for diffusion. Here is a kinetic analysis of asphalt air-blowing that should be helpful in the planning of operations as well as in the design of new units.

CHEMICAL REACTIONS

A study of the chemical reactions involved in the air-blowing of asphalt was made by Goppel and Knotnerus.[2] They confirm the fact observed by others[3,4] that air-blowing not only chemically combines oxygen with asphalt, but it also dehydrogenates asphalt. As a matter of fact, they found that at elevated temperatures, over 50 percent of the reacted oxygen goes to dehydrogenation.

Goppel and Knotnerus further found that the oxygen combined with the asphalt in four forms—esters, hydroxyls, carbonyls, and acids. Over 50 percent of the combined oxygen goes to ester groups, with the remainder about equally distributed to the other groups. They observed that the amount of chemically-combined oxygen increases with more aromatic stocks, and that the amount of combined oxygen decreases as temperature increases.

REACTION TYPE

Since there are so many chemical reactions going on, all that can be done in a kinetic study is to choose a type and order of reaction and see how well it fits. Actually the batch air-blowing of asphalt as it is practiced commercially is a semi-batch reaction as defined by Smith.[5]

The analysis of a semi-batch reaction is complicated. To check it out, data are needed on oxygen concentration in both the air and asphalt. Such data are usually not available to the designer or the operator. Usually all they have as a measure of reaction completion is the rise in softening point of the asphalt.[6]

Thus the designer and operator need a simpler type of analysis using softening point as the variable. And they need to know the limits within which they can safely use this analysis. The simplest type of reaction that might fit batch air-blowing is an irreversible, first-order, batch reaction. The differential equation for such a reaction is as follows:

$$\frac{-dc}{d\theta} = k_o c$$

Say the concentration of reactant material is inversely proportional to the softening point of the asphalt—that is $c = a/R$. Substituting this in the differential equation, and integrating, the equation becomes

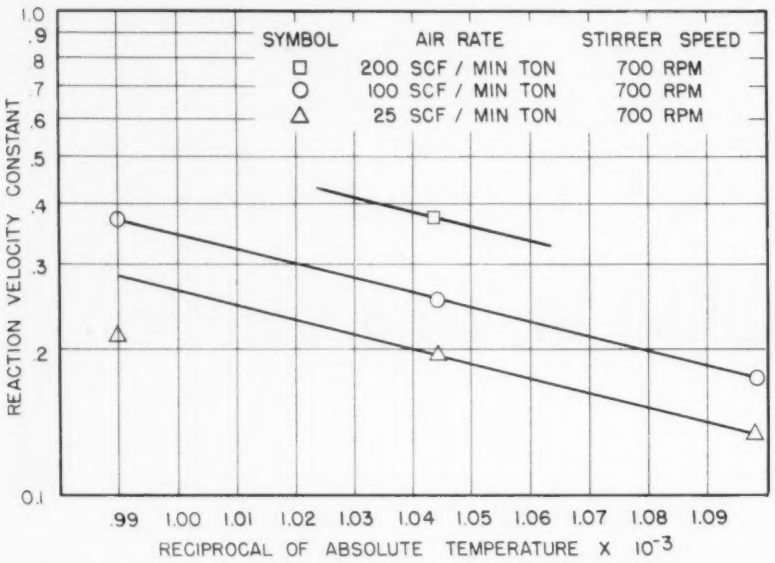

FIGURE 1—Arrhenius plot of Holmgren's[7] data at constant stirrer speed and varying air rates. In making this plot, the final velocity constant was used since it represents average conditions for the entire run.

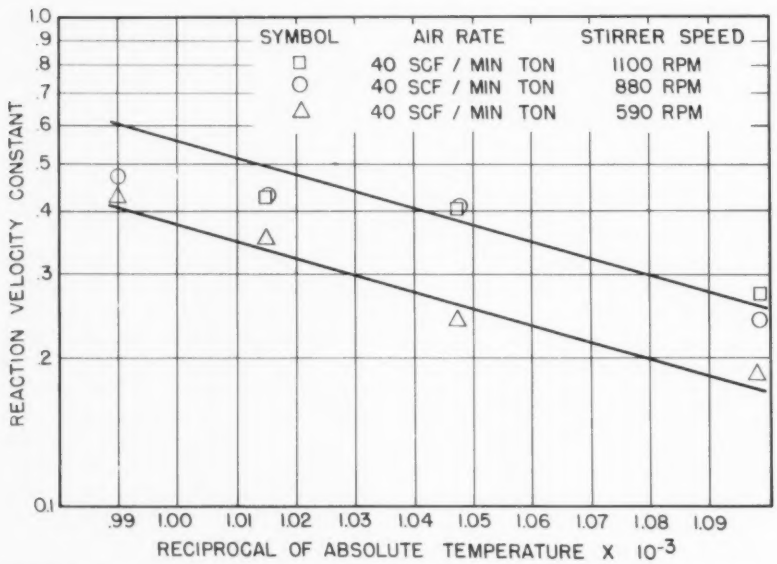

FIGURE 2—Arrhenius plot of reaction velocity constants computed from the data of Rescorla, et al[8], using the first-order batch equation.

$$\theta = \frac{1}{k_o} \ln R/R_o$$

The next step is to check out this equation with some actual test data and see how well it fits.

VELOCITY CONSTANTS

Holmgren[7] made laboratory studies of asphalt oxidizing with both air and oxygen-enriched air. Using his air data to check out the above equation, the results are as shown in Table 1. There is no strong trend in the reaction velocity constants at 100 and 200 standard cubic feet of air per minute per ton of asphalt. But a very strong trend shows up at 550 F. operating temperature and 25 scf air per minute ton.

A clue as to why the strong trend at 550 F. and 25 scf per minute ton comes from the figures for unreacted oxygen in the offgas, also given in Table 1. At the higher air rates, and at the lower temperatures for 25 scf per minute ton, the offgas oxygen-

TABLE 1—First-Order Reaction Velocity Constants

Softening Point, F.	Time Hours	Reaction Velocity Constant	Unreacted Oxygen In Offgas, Percent
500 F. Operating Temperature and 200 scf air Per Minute Ton Asphalt			
82.0	0	....	16.2
99.5	0.5	0.38	16.9
119.5	1.0	0.38	17.3
143.0	1.5	0.37	18.0
168.5	2.0	0.36	18.6
200.0	2.5	0.36	19.2
450 F. Operating Temperature and 100 scf Air Per Minute Ton Asphalt			
81.5	0	....	16.1
94.5	1	0.15	16.9
114.5	2	0.17	17.1
137.5	3	0.17	17.6
162.0	4	0.17	18.4
190.0	5	0.17	19.0
500 F. Operating Temperature and 100 scf Air Per Minute Ton Asphalt			
103.5	0	...	14.4
117.0	0.5	0.24	15.1
133.5	1.0	0.26	15.5
155.0	1.5	0.27	16.3
182.0	2.0	0.28	16.6
202.0	2.5	0.27	17.9
550 F. Operating Temperature and 100 scf Air Per Minute Ton Asphalt			
80.5	0	....	12.2
93.5	0.5	0.30	12.6
111.5	1.0	0.33	13.0
137.0	1.5	0.36	13.8
170.5	2.0	0.38	14.5
206.0	2.5	0.38	16.1
450 F. Operating Temperature and 25 scf Air Per Minute Ton Asphalt			
82.5	0	....	6.2
94.0	1.33	0.10	7.2
114.0	2.67	0.12	8.2
137.0	4.0	0.13	9.3
162.5	5.33	0.13	11.9
197.0	6.67	0.13	14.0
500 F. Operating Temperature and 25 scf Air Per Minute Ton Asphalt			
106.0	0	....	4.0
131.5	1	0.22	4.7
159.5	2	0.20	6.3
199.0	3	0.21	8.7
232.0	4	0.20	10.6
550 F. Operating Temperature and 25 scf Air Per Minute Ton Asphalt			
77.5	0	....	1.0
83.0	0.67	0.10	1.3
93.5	1.59	0.12	1.1
117.0	2.59	0.16	1.5
149.5	3.59	0.18	2.1
189.0	4.34	0.20	3.0
207.0	4.67	0.21	4.1

concentration remains relatively high. But at 550 F. and 25 scf per minute ton, the concentration of oxygen in the offgas is low. At these low concentrations the assumption of a first-order reaction is probably not good.

Thus one limitation to the use of a first-order, batch-reaction analysis shows up. It cannot be used for checking operations or design when the air rate is low and the temperature high. Data from commercial units[8] confirm this and show that this analysis should not be used much above 500 F. for low air rates. This is not a serious limitation, however, as few commercial operations go much over 500 F.

There are two reasons for not operating at a temperature much over 500 F. One reason is that temperatures start coming too close to the flash point for safe operation. The other reason is that blowing losses of oil start becoming sizeable.

CONSISTENCY

To check consistency, the data of Table 1 is shown as an Arrhenius plot in Figure 1—that is, a semi-log plot of reaction velocity constant against the reciprocal of absolute temperature. In making this plot the final velocity constant was used since it represents average conditions for the entire run.

Figure 2 is an Arrhenius plot of reaction velocity constants computed from the data of Rescorla, Forney, Blakey, and Frind,[3] using the first-order batch equation given above. In computing these constants the initial softening point was assumed to be 80 F.

The Arrhenius plots show two interesting things. One is that the reaction velocity constant is a function of air rate and stirrer speed. The other point of interest is that there is a general tendency for the constant to fall off at high temperatures and low air rate if the stirrer speed is over 700 rpm.

The fact that the reaction velocity constant is a function of air rate and stirrer speed can be due to the reaction being partly diffusion controlled. The effect of diffusion on the over-all reaction rate is discussed later.

There are several possible explanations for the drop-off at high temperatures. One explanation is that there are two general reactions occurring. The reaction to form asphalt. And a decomposition reaction that is accelerated at high temperatures. Goppel and Knoterus[1] show a progressive decomposition of ester groups with increasing temperature, which supports this explanation.

Another possible explanation could be the relative rates for reaction and diffusion. At lower temperatures, when the reaction rate is slow, the effect of diffusion could be negligible. And at higher temperatures, as the reaction rate increases, the diffusion

TABLE 2—Effect of Stirrer Speed on Reaction Velocity Constant Runs At 500 F. and Air Rate of 25 scf Per Minute Ton

Softening Point, F.	Time, Hours	Velocity Constant
Stirrer Rate = 700 rpm		
106.0	0	....
131.5	1	0.22
159.5	2	0.20
199.0	3	0.21
232.0	4	0.20
Stirrer Rate = 1,300 rpm		
88.0	0	....
106.0	1	0.19
131.0	2	0.20
164.5	3	0.21
213.0	4	0.22
240.0	4.8	0.21

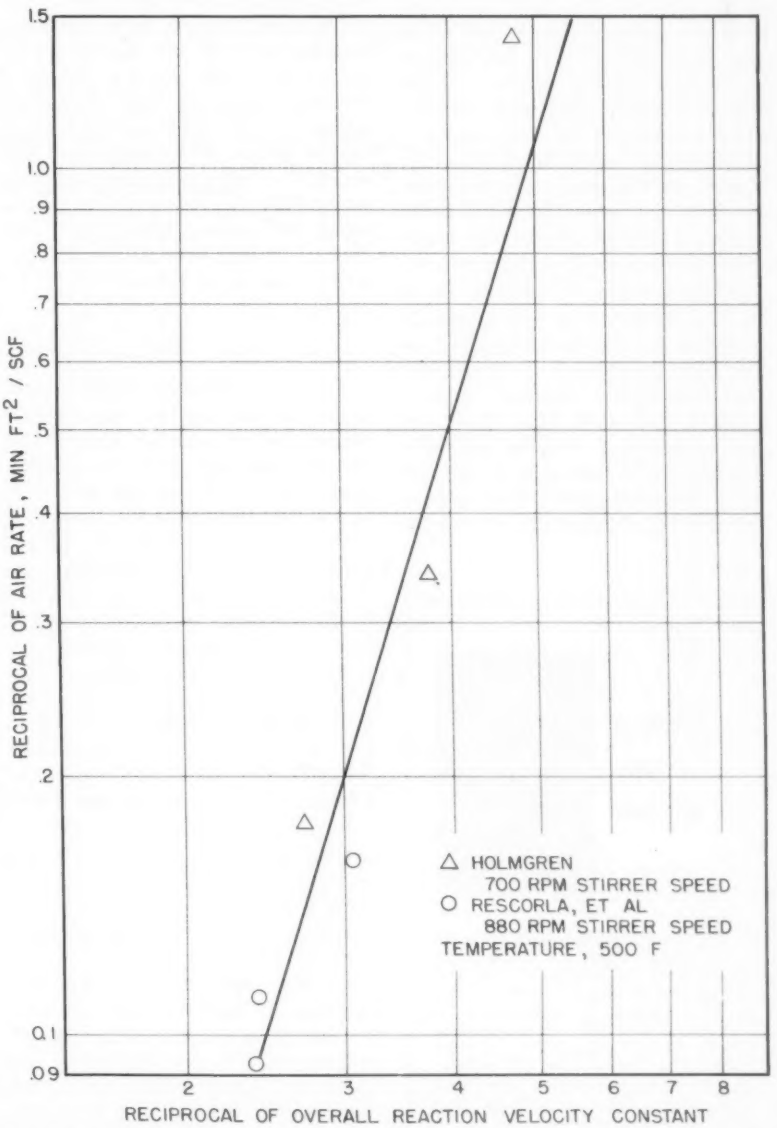

FIGURE 3—Plots reciprocal reaction-velocity constant against reciprocal superficial air velocity at 500 F. In making this correlation, superficial air velocity is the SCF/M of air divided by the cross-sectional area of the air-blowing vessel.

rate could start to control and thus cause the drop-off.

Neither of these explanations are the whole story. The decomposition theory falls down because the drop-off in velocity constant does not always occur at high temperature. The theory of drop-off due to low diffusion rate falls down because as shown in Figure 2, the drop-off occurs at high stirrer speed which gives a high diffusion rate while there is no drop-off at the low stirrer speed which gives a low diffusion rate.

Another explanation that is consistent with all the data has to do with the oxygen concentration as mentioned earlier. This explanation is that it is possible that the reaction does not follow first-order behavior when conditions are such that the oxygen concentration is low. There is support for this theory that the reaction does not behave in a first-order manner at low oxygen concentrations —say about 1 or 2 percent oxygen.

In the last two softening points of the Holmgren, run at 550 F. and 25 scf/mt of air, the outlet oxygen concentration is about 3 or 4 percent. The incremental reaction velocity constant computed from these last two points is 0.27. Plotting this value on Figure 1, it falls close to the line which indicates that when concentration is up, the reaction approaches first-order behavior even at high temperatures and low air rates.

DIFFUSION

The Arrhenius plots show that the reaction velocity constants are a function of both stirrer speed and air rate. This indicates that diffusion partially controls the air-blowing reaction. In a heterogeneous reaction such as air-blowing, the over-all reaction velocity constant can be a function of three things—liquid diffusion, chemical reaction, and vapor diffusion.

Sherwood and Pigford[9] discuss simultaneous absorption and chemical reaction. For the case where the concentration of the solute in the main body of the liquid is low, for a first-order reaction, they show that reciprocals of diffusion coefficients can be added to the reciprocal of a function of the reaction-velocity constant. This suggests trying a similar attack for relating stirrer speed and air rate to the over-all reaction velocity constant, as follows.

$$\frac{1}{k_o} = \frac{1}{f(k_L)} + \frac{1}{f(k_c)} + \frac{1}{f(k_v)}$$

The runs shown in Table 1 were made in an oxidizer that had a stirrer. For all runs in Table 1 the stirring rate was 700 rpm. Holmgren[7] made a second run at 500 F. and 25 scf per minute ton, increasing the stirrer rate to 1,300 rpm. Table 2 compares the reaction-velocity constants for the two runs as computed by the first-order batch equation. The fact that the reaction velocity constants are about the same for the two stirrer rates indicates that liquid diffusion is not controlling at 700 rpm. This is further confirmed by the way the 880 and 1,100 rpm points of Figure 2 fall about on the same curve.

Since liquid diffusion is not controlling at stirrer speeds of 700 rpm and higher, k_L must be large and $1/f(k_L)$ must be about zero. The chemical reaction rate should be a constant for any given temperature. Since the vapor diffusion rate is a function of superficial air velocity, for any given temperature and stirrer speed over 700 rpm, a log-log plot of the reciprocal of the over-all reaction velocity constant against reciprocal of air velocity should plot as a straight line if the reciprocals are additive.

Figure 3 is a plot of reciprocal reaction-velocity constant against reciprocal superficial air velocity at 500 F. Superficial air velocity used in Figure 3 is the SCF/M of air divided by the cross-sectional area of the air-blowing vessel. For stirrer speeds of 700 rpm and above, where liquid diffusion is not controlling, the points fall roughly on a straight line.

The fact that all six points fall roughly on a line may be coincidence because they are from data on two different asphalts. But since the points for each asphalt give some sort of line, changes in air rate can be allowed for in this manner. Data from commercial units plotted in the manner of Figure 3 fall roughly on a line.[8] But as would be expected, this line for commercial units without stirrers is displaced from the line of Figure 3, and has a different slope.

CONCLUSIONS

A first-order kinetic analysis describes the behavior of the air-blowing reaction except at high temperatures and low air rates. This type of kinetic analysis gives a middle-of-the-road basis for plant design and control of operations. There are undoubtedly certain situations where the use of empirical rules-of-thumb are all that can be justified. But at the other extreme, a more sophisticated kinetic analysis does not seem to be justified considering the data that are usually available and the nature of the operations.

NOMENCLATURE

c	Concentration of material that reacts with air to form asphalt
Θ	Time, hours
k_c	Chemical reaction rate
k_L	Liquid diffusion coefficient
k_o	Over-all reaction velocity constant, reciprocal hours
k_v	Vapor diffusion coefficient
R	Softening point at time Θ, F
R_o	Initial softening point, F

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Evaluate Pollution Control This Way

Here's the method used by Humble in evaluation and appraisal of pollution control methods

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Baytown, Texas

AT THE END of World War II, Humble's Baytown refinery had a number of obsolete pieces of equipment and an effluent system that had grown like Topsy through the 30 years of growth of the refinery.

As was customary for many industries in those days, little thought was given to the effluent problems except where they affected the profit and loss of the company. Essentially all of the waste streams were routed to the adjacent ship channel or to another stream north of the refinery for ultimate disposal into Galveston Bay.

This was not particularly bad for anyone concerned during the early years of the refinery; however, as others came into the area to build plants, it was soon apparent that pollution of the bays and streams was a problem rapidly approaching serious magnitudes.

During the war years, like other industries throughout the country, Humble built units on a crash basis

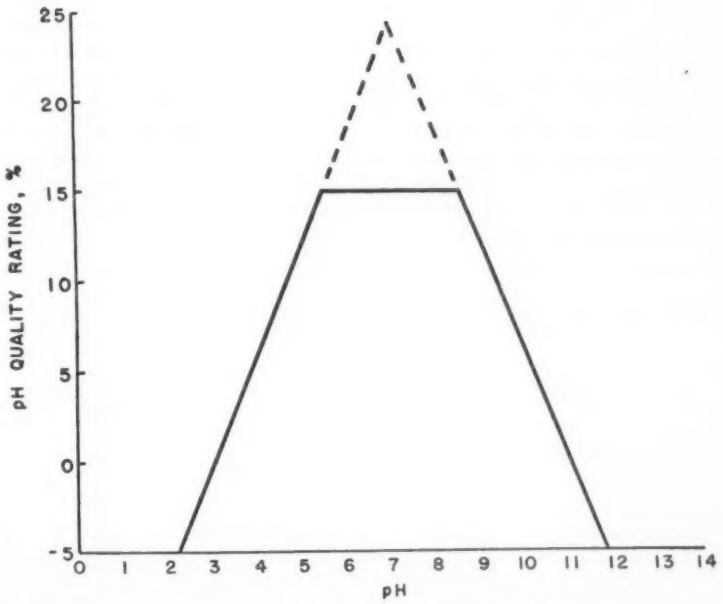

FIGURE 1—Shows the percentage quality rating assigned to pH improvement.

Evaluate Pollution Control This Way . . .

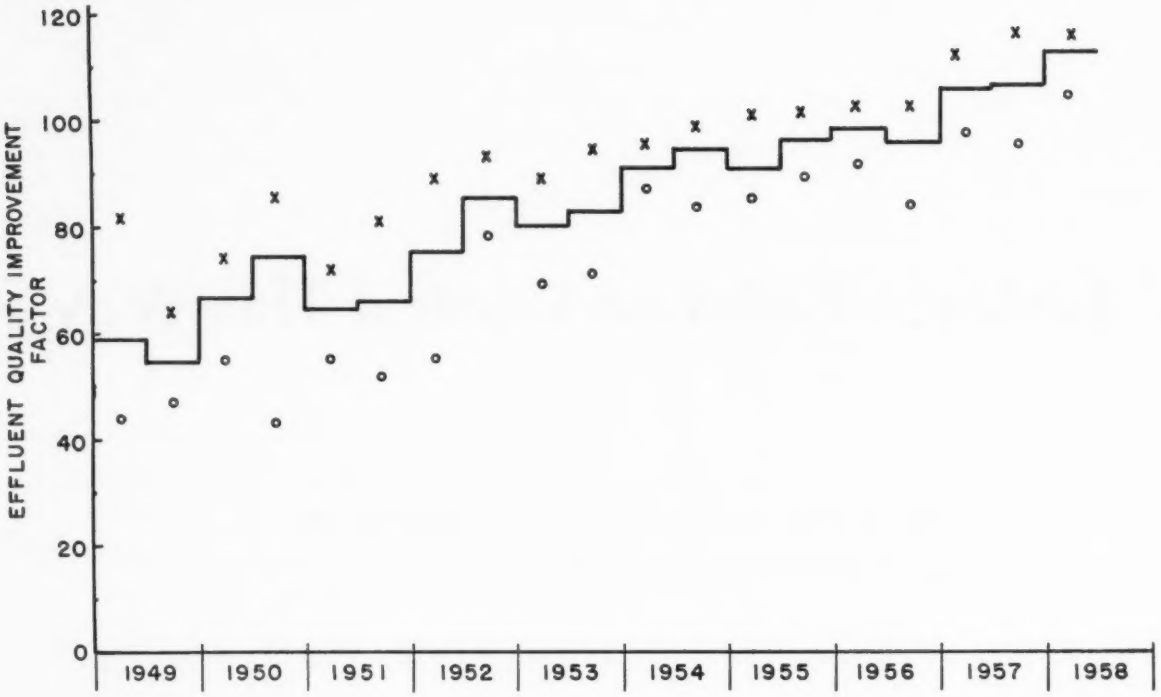

FIGURE 2—Since 1949, these improvements in effluent quality have been shown by using the grading system.

and deleted items that might normally have been included during peace-time years.

Thus, at the end of the war we were faced with a rather serious problem of waste disposal. We had very little modern equipment for handling any of the waste streams. One exception was sulfide caustic which was being segregated for sales to a paper mill. Humble's management recognized that the pollution problem was a serious one that had to be solved before any extensive modernization of the refinery could be considered.

Initial Survey. The first step in approaching the problem of effluent improvement required a preliminary survey to establish what particular inspections of quality were desirable in defining the quality of the effluent. Considerable effort was required to select the particular physical and chemical inspections which were used throughout the program to measure the effluent quality. One of the more difficult phases of setting up an extended effluent improvement program is the matter of establishing realistic goals.

In formulating the Humble program, we soon found that the published literature on the subject of pollution abatement was rather meager and that the statutes governing water pollution were even less helpful. A small amount of information was obtained from literature published by the API and from personal discussions with members of API's Committee on Disposal of Refinery Waste. Since 1947, there has been a number of contributions to the literature that

TABLE 1

Property	Goal
Temperature, F	100 Maximum
Oil Content, ppm	77 Maximum
Dissolved Oxygen, ppm	5.0 Minimum
pH	5.5 to 8.5
Turbidity, ppm	100 Maximum
Chemical Oxygen Demand, ppm	10 Maximum
Suspended Solids, ppm	50 Maximum
Sulfides, ppm	1.0 Maximum
Biochemical Oxygen Demand, ppm	40 Maximum

TABLE 2

Column	1	2	3	4	5	6
	Typical Condition During 1948	Sanitary Sewer System	Revise Main Separator	Eliminate Salt Water For Cooling	Increase Capacity To Sell Spent Caustic	Bay Water pump-over
Temperature, F	125	125	125	114	114	107
Oil, ppm	700	649	609	599	594	557
Dissolved Oxygen, ppm*	—6.0	—6.0	—6.0	—6.0	—5.7	—1.5
pH	3–11	3–11	3–11	3–11	3–11	5–11
Turbidity, ppm	500	493	484	484	484	364
COD, ppm	65	63	61	72	61	46
Suspended Solids, ppm	190	163	143	133	133	93
Sulfides, ppm	20	20	20	26	23	14
BOD, ppm	200	193	193	169	160	125
Total Effluent, M gpd	38.0	38.0	38.0	32.5	32.5	60.5
Estimated Cost, M$	...	318	305	449	163	50

* Negative quality indicates immediate oxygen demand.

indicates that the goals we selected have been somewhat realistic even though they were quite arbitrary when they were selected. Details of these goals are shown in Table 1.

Comprehensive Inplant Survey. After making the preliminary survey and establishing which chemical and physical inspections were desirable, a comprehensive survey of the major streams within the refinery was made in order to prepare a table which would show the contribution of various operations to the over-all pollution. A sample of these data is shown in Table 2. The physical and chemical inspections are shown for the condition of the total effluent as it existed in 1948 and the effect of various projects is shown in subsequent columns.

For example, it was estimated that the sanitary sewer system would have no appreciable effect on the temperature, dissolved oxygen, and pH, but that it would reduce the oil content and suspended solids, etc. The elimination of salt water was estimated to reduce the temperature approximately 11 F, but this project was expected to have an adverse effect on chemical oxygen demand (COD) and sulfides. You will note that the cost of the project is tabulated along with the physical effect expected.

The five items listed in Table 2 represent only part of the original program. Discussion of the total program in detail is not necessary to illustrate the evaluation methods used. These five items were selected for discussion since they illustrate the problem and were installed as predicted without major modification. The following brief descriptions of the five items illustrate why these were considered for installation.

1. Sanitary Sewer System. Segregation of sewage from the industrial waste was one of the first things considered from a health and sanitation standpoint. A master plan was prepared for stepwise installation. The first step includes a treating plant and a gathering system to serve a large portion of the refinery. The sanitary sewer system was expected to improve the effluent turbidity, suspended solids, COD, and BOD. The removal of solids was expected to reduce the emulsions in the oil separator.

2. Main Separator. The earthen oil-water separators at several locations throughout the refinery were known to be comparatively ineffective. In the over-all program, it was decided to eliminate most of these and route all industrial waste through a single final separator. This item provided for installation of continuous mechanical and oil skimming and sediment removal facilities in Separator 10 which was built in 1929. Previously, the separator was inefficient because of periodic loss in volume due to the build-up of solids. Separator modernization was predicted to reduce the amount of oil, turbidity, and suspended solids in the final effluent.

3. Elimination of Salt Water for Cooling. The relatively large quantity of once-through salt water was objectionable in the effluent since it was hot and deficient in oxygen. In addition, the dissolved solids in the salt water contributed to emulsion stabilization. Salt water was used only on the older equipment such as shell stills and cracking coils. Newer units all utilized the more desirable recirculated cooling tower water. This project was closely related to replacement of obsolete equipment; most of the salt water usage was eliminated by installation of new process equipment. Thus, it was necessary to install recirculated water systems for only 20 percent of the total salt water load. Elimination of salt water for cooling was predicted to reduce the volume, temperature, suspended solids, and oil content of the final effluent.

4. Increase Capacity to Sell Spent Caustic. This item provided for enlarging the capacity of the system to collect and concentrate spent sulfide caustic. A new concentrator equipped with a fume burner to reduce the atmosphere pollution was included in this project.

5. Bay Water Pumpover. The "pumpover" was one of the more significant projects in the over-all program. The "pumpover" is simply a means of pumping a large quantity of cool, oxygen-saturated water from an adjacent bay into the outfall canal. The cost of this project was small compared with the improvement received. The quantity of water pumped was approximately equal to the amount of effluent water. This dilution was expected to have a desirable effect on each of the quality inspection items.

These data, tabulated in this manner, made it possible to integrate the effluent improvement projects with various refinery modernization plans that were being proposed. An effort was made to establish as accurately as possible the quantity, quality and desired disposition of each stream that contributed to refinery waste.

In some cases, it was possible to modify the waste stream by changing the process operation to eliminate the bad features of the waste stream. In other cases, it was necessary to install new facilities to remove the contaminants from the waste stream. In order to construct a complete tabulation which showed all of the details required for such a study, it was necessary to estimate the over-all effect of many of the changes predicted.

In retrospect, our predictions

TABLE 3—Effluent Quality Improvement Factors

Quality	Percent of Total Problem	Percent Unit Improvement Factor	Start of Program	Goal
Temperature, F	10	0.4000	125	100
Oil Content, ppm	15	0.0240	700	77
Dissolved Oxygen, ppm*	20	1.8200	—6.0	5.0
pH	15	6.0000	3.0—11.0	5.5—8.5
Turbidity, ppm	5	0.0125	500	100
Chemical Oxygen Demand, ppm	5	0.0909	65	10
Suspended Solids, ppm	5	0.0358	190	50
Sulfides, ppm	10	0.5260	20.0	1
Biochemical Oxygen Demand, ppm	15	0.0938	200	40

* Negative quantity indicates immediate oxygen demand.

were quite satisfactory; however, the need for a better yardstick became apparent after completion of the first few projects. Management expressed their willingness to appropriate money for effluent improvement but wanted assurance that optimum value would be received.

Initially, the effluent improvement program was set up in several construction steps based on cost and obvious improvement in the effluent quality. The stepwise program was desirable from the standpoint of cash expenditures and field evaluation. Management justly wanted to review the results of each step before continuing with the subsequent steps. In the process of allocating money for capital expenditure, it was necessary to compare effluent projects with projects showing monetary returns. Occasionally it was necessary to select one of several alternate effluent projects.

Since all of these projects on effluent were intangible, the need for a yardstick of some sort was quite evident. To help answer these questions on a consistent basis, a grading or an evaluation system was prepared. The grading system now used has been altered only slightly since it was initially prepared in 1953.

GRADING SYSTEM

The system is based on the assignment of relative importance to each item of the quality measurement. We simplified the list of qualities to nine items of quality which are shown on Table 3. The relative importance of each of these is indicated on a percentage basis in the first column. The arbitrary assignments were based on the best judgment as to the relative effect on marine life. The percentage values coupled with the inspections of the effluent either actual or predicted made it possible to get a single value which represented the condition of the effluent.

The assigned values are tabulated in Table 3 along with the actual and desired effluent qualities. For example, the temperature in the base case was 125 F. and the desired temperature is 100 F. or an improvement of 25 F. The temperature effect was assigned a value of 10 percent of the total problem, thus each increment of 1 F. would be equivalent to 10 percent divided by 25 F. or 0.4000 percent per degree. Similar improvement factors listed for the remaining items are straightforward linear relationships with the exception of the improvement factor for pH. The pH is handled in a slightly different manner since the desired value is in the center of the scale. (See Figure 1)

Using these factors, it is possible to express each project on a comparable basis. Detailed analysis of each of the five projects discussed previously are shown in Table 4. The predicted incremental effect on the inspections of the effluent are tabulated in the first column (A) under each project. The percent improvement for each incremental effect is tabulated in the second column (B) under each project. This presentation permits ready comparison of each project on a comparable basis of evaluation. It is easy to spot the items that are costly.

COMPARISON OF ESTIMATED AND ACTUAL EXPENDITURES

After installation of several of the effluent improvement projects, it was found advisable to resurvey the effluent condition to determine how accurate the predictions were. It was originally estimated that the program could be installed in a period of approximately five years and that the goals desired at the beginning of the program would be attainable after installation of these projects. There was a total of some 23-25 projects ranging in cost from $6,000 to $1,500,000 each. The estimated expenditure of approximately $5 million was considered adequate to install all of the anticipated effluent improvement projects.

After spending approximately $3,500,000 for effluent improvement projects, a review of the progress was made and compared in detail with the predicted progress. Due to the fact that the program was not followed rigorously and process equipment modernization was not predicted exactly in the survey, discrepancies in the improvement can be explained. One notable example is in the processing of lube oils.

In the original program, a waste chemical treating plant was installed to pretreat the waste acidic material from the lube treating operations

TABLE 4—Incremental Improvement

Improvement Step		1		2		3		4		5	
	Percent of Problem	Sanitary Sewer		Revise Separator		Eliminate Salt Water		Sell More Spent Caustic		Bay Water Pumpover	
		A	B	A	B	A	B	A	B	A	B
Temperature, F	10	..	..	..	..	11	4.4	..	..	7.0	2.8
Oil, ppm	15	51	1.2	40	1.0	10	0.2	5.0	0.1	37.0	0.9
Dissolved Oxygen, ppm	20	..	..	..	..	..	..	0.3	0.5	4.2	7.7
pH	15	..	..	..	..	..	..	..	..	1.0	6.0
Turbidity, ppm	5	7	0.9	9	1.1	..	..	..	..	120.0	1.4
COD, ppm	5	2	0.2	2	0.2	—11	—1.0	11.0	1.0	15.0	1.4
Suspended Solids, ppm	5	27	1.0	20	0.7	10	0.4	..	..	40.0	1.4
Sulfides, ppm	10	..	..	..	..	— 6	—3.0	3.0	1.5	9.0	4.7
BOD, ppm	15	7	0.6	..	..	24	2.2	9.0	0.8	35.0	3.3
Total	100	..	3.9	..	3.0	..	3.2	..	3.9	..	29.6
Cost, $		318,000		305,000		449,000		163,000		50,000	
Cost Ratio, $ Percent		81,000		102,000		140,000		42,000		1,700	

(A) Estimated Improvement Incremental Effect.
(B) Estimated Percent Improvement.

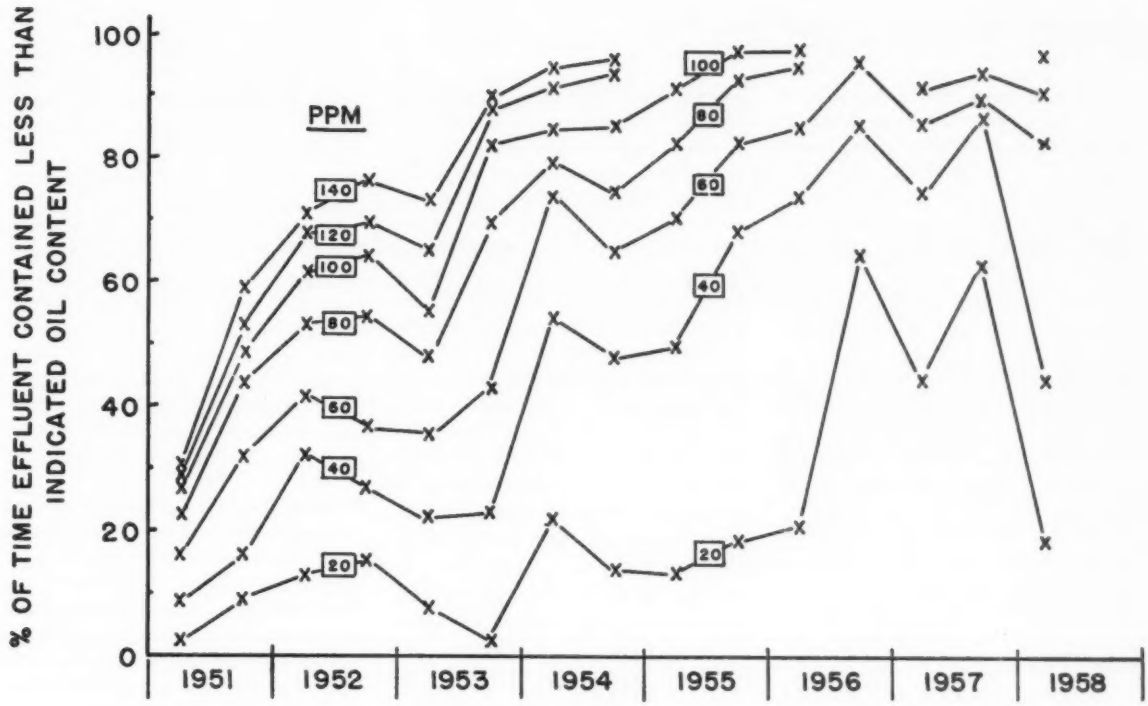

FIGURE 3—These improvements in oil content of the refinery effluent resulted from the pollution abatement program.

along with waste chemicals from various other operations within the refinery. But before this plant, known as the effluent filtration unit (EFU), was placed in operation, the lube plant operations were altered radically. The effect of the lube plant modernization on the effluent quality was not adequately evaluated, and it was necessary to modify the operation of the EFU.

The explanation of these discrepancies is aided considerably by the use of the grading system discussed in a previous paragraph. Two modifications of grading have been used. These differ slightly in absolute values but both show the relative quality on a practical, consistent basis. The system initially set up at a maximum possible rating of 100 percent since each of the items had a stop-out at the assigned percent of the total problem. In the case of the pH shown in Figure 1 the curve would be discontinuous at the range 5.5 to 8.5. Likewise, on each of the other items, values in excess of the assigned percent were not possible. Another system currently used allows additional credit for better than goal conditions.

For example, by the second system, a pH of 7 would be evaluated at 24 percent instead of a maximum of 15 percent by the first system. And in the case of the other items, additional credit would be allowed for better than goal conditions so that the total index of the refinery effluent could easily be in excess of 100 percent. This system is used on a routine basis since it is easy to apply and does show some additional sensitivity in the upper ranges.

So far, the grading system has been entirely satisfactory; however, it may be possible that modifications will be required in the future as more informative data become available. The list of nine items does not include toxic materials and other polluting agents which could possibly be present. We continue to evaluate and exercise control on these items but simply do not include them in the grading system. As process changes are made, we may have to modify the system to effectively grade the effluent quality.

TABLE 5—Average Cost Indexes

Item	AVERAGE INVESTMENT COST	
	$/ppm	$/Lb./Day
Temperature*	40,000	.....
Oil Content	2,400	7.20
Dissolved Oxygen	182,000	546.00
pH**	600,000	.....
Turbidity	1,250	3.76
Chemical Oxygen Demand	9,090	27.30
Suspended Solids	3,580	10.70
Sulfides	5,260	15.80
Biochemical Oxygen Demand	9,380	28.20

* Temperature unit is Degrees F
** pH unit is 1.0 pH

One of the most important uses of this grading system is in the design of new process equipment. Humble has recently completed the construction of several major units. The design of these units was considered incomplete until adequate effluent facilities were insured. Such items as unit separators, additions to the sour water system, expansion of the spent chemical gathering system, etc., were just as much a part of the process as the unit charge pump. Each possible waste stream was evaluated in the process design stage, and the disposition of the waste was dictated by its effect on the refinery effluent quality and was routed to those treating units most suitable for handling the particular type of waste. In most cases, this required extension of existing waste treating facilities; however, in some cases, it was necessary to install small waste disposal units within

the process area. In making the decision as to whether money should be spent for treatment of the waste stream or whether it should be discarded to existing sewer facilities, the grading system was used to estimate monetary credits or debits.

For example, it has been estimated that on the average we have invested in effluent treating facilities $28 for each pound per day of BOD removed. If the process design indicates a stream with a large contribution of BOD, it is a simple matter to evaluate this contribution at $28 per pound and then install the cheapest facilities to remove or lower the BOD to an acceptable level. In some cases, this would be pretreatment within the battery limits; in other cases, it may be disposal into the refinery sewer for subsequent treating.

An analysis of the actual cost and improvement makes it possible to assign an equivalent investment cost to each increment of effluent. In preparing the analysis summries in Table 5, adjustments were made to reflect the best estimate of investment cost applicable to effluent improvement. Improvements resulting from modernization of process units were considered to require no expenditure for effluent improvement. In addition, there was a noticeable improvement in effluent quality immediately after the study was started but prior to installation of any equipment, primarily as a result of better operation of existing equipment. After correcting for the above factors, the unit cost of effluent improvements is calculated to average $100,000 per percent improvement. Using this over-all average individual unit cost can be calculated. These values are tabulated in Table 5. These values are very useful in design evaluations, but are only first approximations.

The capital investment for effluent equipment on new installations averages about 1 percent of the total investment. The actual investment on specific units is dependent on so many factors that the average is seldom applicable.

Additional Uses of the Grading System. The grading system has been very useful in showing the trend of quality of the refinery effluent since the beginning of the program. This is illustrated in Figure 2 where the improvement has been on a detailed basis. For example, the oil content in the refinery effluent is of importance economically and has been recorded in detail as shown in Figure 3. Similar data for other inspections could be prepared; however, the average conditions for most of the inspections are adequate for showing the trends.

One of the shortcomings of the grading system is that it does not recognize the statistical average which may be a more desirable method of evaluating the data. Possibly, the grading system should be revised to incorporate some better presentation of the percent time we are actually within the goal, since we are striving to be within the limits 100 percent of the time. Such a system would require considerable tabulation and computation; however, we have no definite plans to recalculate our data at the present.

Another shortcoming of the grading system employed is that it does not take into account several items that are known to contribute to the toxicity or over-all pollution. These items are presently evaluaetd separately. We have not found it desirable to rework the system to include these items, since their contribution is either undefined or insignificant.

Conclusions. We believe that Humble has made a sensible approach to a complex effluent problem. The stepwise approach to an end goal permitted maximum use of over-all capital. Replacement of the obsolete equipment with modern equipment in several cases made appropriation of money for effluent unnecessary. Decisions to spend effluent improvement money wisely were based initially on engineering judgment and later on a relative grading system based on actual improvement. This grading system has been very useful in evaluating new projects which effect effluent quality. The system used at Humble is specific to the Baytown refinery, but the methods employed are applicable, with appropriate modifications, to any other location.

This article covers the work of many people engaged in the pollution abatement activities. E. Q. Camp, D. M. Haas, and G. W. Wilson were responsible for most of the over-all planning. S. O. Brady and E. V. Erxleben, and Dr. C. L. Umholtz contributed to the tabulation and evaluation of data. Credit for seeing that the program was successful is given to Mr. James Harrop, the assistant plant manager, who has kept in close contact with the condition of the refinery effluent. The material was presented at the Third Annual Water Disposal and Stream Pollution Conference of the Western Petroleum Refiners Association, October 1, 1958. ##

About the Author

John H. McClintock is a senior chemical engineer in the Technical division, Manufacturing department, at Humble Oil & Refining Co.'s Baytown, Texas, refinery. He has been with the division since 1940, when he received a B.S. degree in chemical engineering from The University of Texas. His early years were spent in the general area of technical service work on utilities and cooling towers. Since 1953 he has been with the Distillate Finishing section working on hydrofining and light oil treating and pollution abatement problems. At present, McClintock's main interest is in pollution abatement and utilization of air cooled exchangers.

Heat Transfer Nomographs

Part 5—Nusselt numbers for liquids and gases
PART 6—Internal heat transfer for Reynolds numbers larger than 10,000
Part 7—Heat transfer for liquids and gases inside tubes

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Instituto de Investigaciones Industriales
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Monterrey, Mexico

HEAT TRANSFER equations for fluids inside tubes, without change of phase, and with Reynolds numbers larger than 10,000 can be quickly determined from Nomograph 13. Figure 14 shows another useful nomograph for finding the film coefficient for water flowing inside tubes.

Nomograph 13 is based on the familiar Dittus Boelter equation recommended by McAdams,[14] Kern,[13] and others to calculate film coefficients of liquids and gases, heated or cooled for Reynolds numbers larger than 10,000. If the Prandtl number is less than 10, this equation can be used for Reynolds numbers larger than 2,100.[19]

Nomograph 13 solves the formula:

$$Nu = 0.023\ Re^{0.8}\ Pr^{0.4}$$

Where: Nu, Nusselt number
Pr, Prandtl number
Re, Reynolds number

Example: Find the Nusselt number, if Reynolds number is 12,000 and Prandtl number is 15.

Solution: Using Nomograph 13, the Nusselt number is found to be 125.

Film Coefficient for Water Inside Tubes—The Nomograph No. 14 solves the formula:

$$h = 150\ (1 + 0.011\ t)\ (V')^{0.8}/(D')^{0.2}$$

Where: h, Film coefficient, Btu/h. sq. ft. F.
t, Temperature, F.
V', Velocity in the pipe, ft./sec.
D', Diameter, inches

Example: Find the film coefficient when V' is 3 ft./sec. temperature, 100 F. in a 1 inch Std. (I.P.S. 40) pipe.

Figure 14 on following page.

Solution: Using Nomograph No. 14 the film coefficient "h" is found to be 760 Btu/h. sq. ft. F.

Key : V' — t : L
L — D' : h

LITERATURE CITED
[13] Kern, D. Q., Heat Transfer Processes, McGraw Hill Book Co., Inc., 1950.
[14] McAdams, W. C., Heat Transmission, McGraw Hill Book Co., Inc., 1942.
[19] Stoever, H. J., Applied Heat Transmission, McGraw Hill Book Co., Inc., 1941.

TO BE CONTINUED

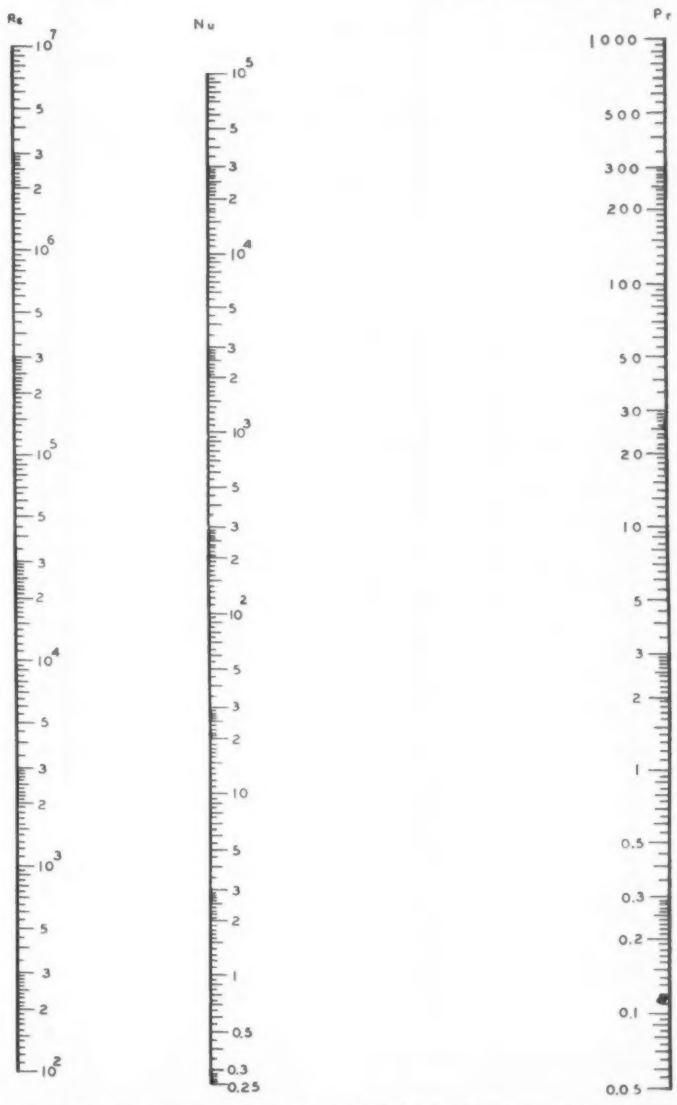

FIGURE 13—Heat transfer equation for fluids inside tubes without change in phase, Reynolds numbers larger than 10,000.

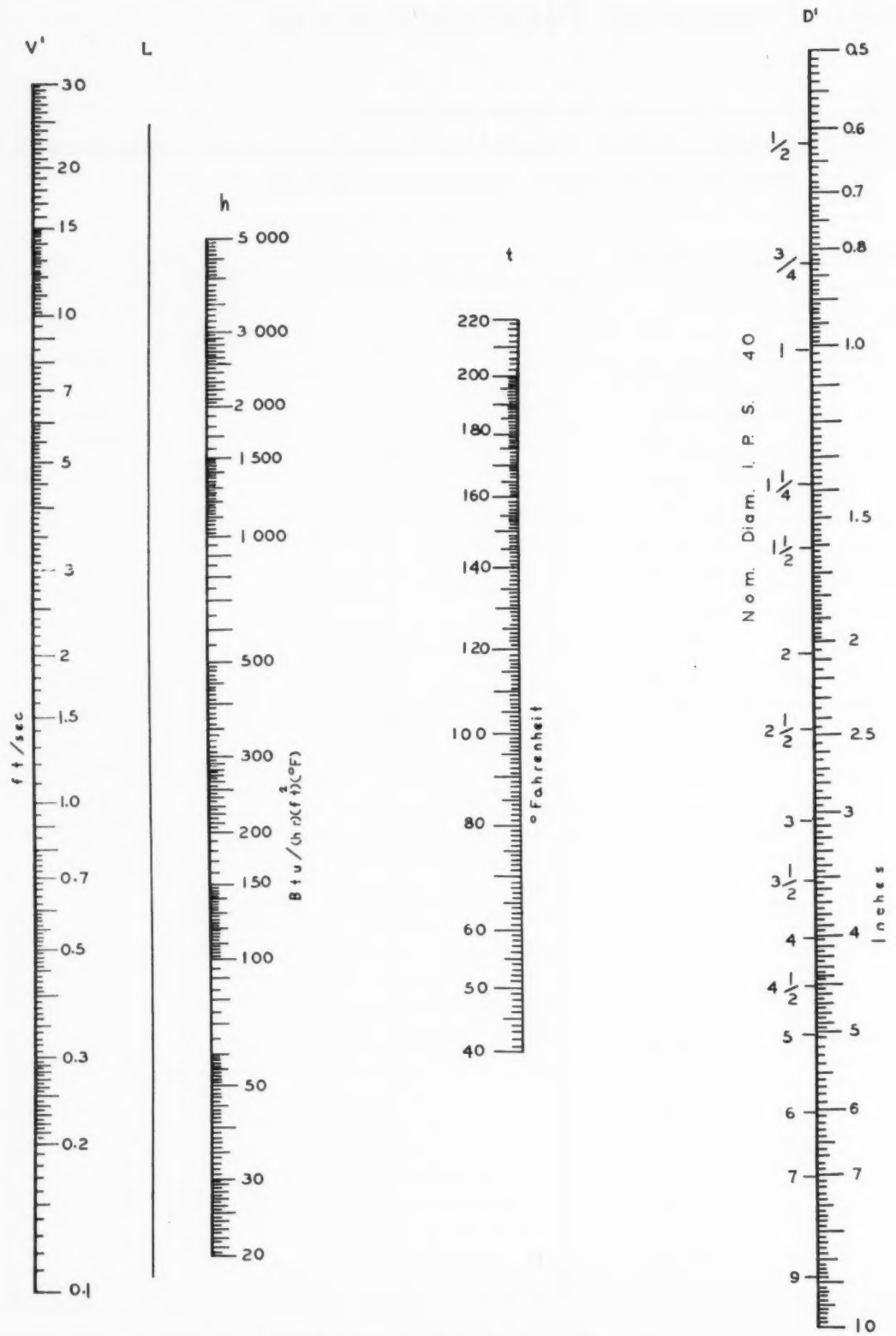

FIGURE 14—Film coefficients for water inside tubes.

From rich ethylene streams . . .

Remove and Recover Acetylene

Get into acetylene petrochemicals to the tune of 2 million pounds per year by recovering acetylene from your ethylene plant rich gas stream

W. H. Stanton
Monsanto Chemical Co., Texas City, Texas

MONSANTO CHEMICAL Company at Texas City has facilities for production of ethylene from two plants. One plant cracks propane; the other *n*-butane. Both plants in producing ethylene make acetylene as a by-product. The acetylene content of the cracked gas from the propane cracking operation averages about 0.35 pounds per 100 pounds ethylene produced, and from the *n*-butane cracking operation about 1.0 pounds per 100 pounds ethylene produced. These figures represent averages; they can readily vary ± 50 percent based on cracking conditions.

Monsanto also has an acetylene plant at Texas City where acetylene is made from natural gas. Acetylene so produced is consumed in acrylonitrile and vinyl chloride production.

Acetylene in ethylene has proved harmful in styrene production—Monsanto's main ethylene consumer. The reactive acetylene forms undesirable by-products in alkylation, wasting valuable benzene. It is good economics to remove or destroy the acetylene in the ethylene prior to its use in alkylation.

The first problem centered around choosing either a method to remove the acetylene or one to convert it to ethylene. Evaluations were made comparing hydrogenation of acetylene with absorption and recovery of the acetylene. Such a study is interesting enough to be the subject of a separate article. It will suffice to say here that, although recovery involved a greater capital outlay, the higher value of the resulting by-product acetylene seemed to justify this path.

Scope. The combined ethylene product stream from the producing plants has the following composition:

	Product Ethylene Stream	
	Weight Percent	Mole Percent
Methane	1.41	2.46
Acetylene	.73	.78
Ethylene	93.06	92.30
Ethane	4.80	4.46
	100.00	100.00
Temperature	5 F	
Pressure	425 psia.	

It is desirable to separate this stream so the ethylene rich stream contains 0.005 mole percent acetylene maximum and is available at 400 psia for distribution. The 0.005 mole percent acetylene figure is not difficult to obtain and represents an acceptable specification for commercial ethylene.

The acetylene rich stream was specified at 95 mole percent purity with ethylene as the impurity. The acetylene must be free of solvent contamination. The required pressure for distribution is 16 psia.

Thus, with the feed and product streams defined, equipment for accomplishing the desired separation was specified. A conventional absorber, pre-stripper, stripper arrangement modified to suit the peculiar needs of this separation and using dimethyl formamide (DMF) as a solvent, was chosen.

Acetylene-Ethylene-DMF. Trade literature[6] furnished detailed information on the binary systems, acetylene-DMF and ethylene-DMF. Solubilities

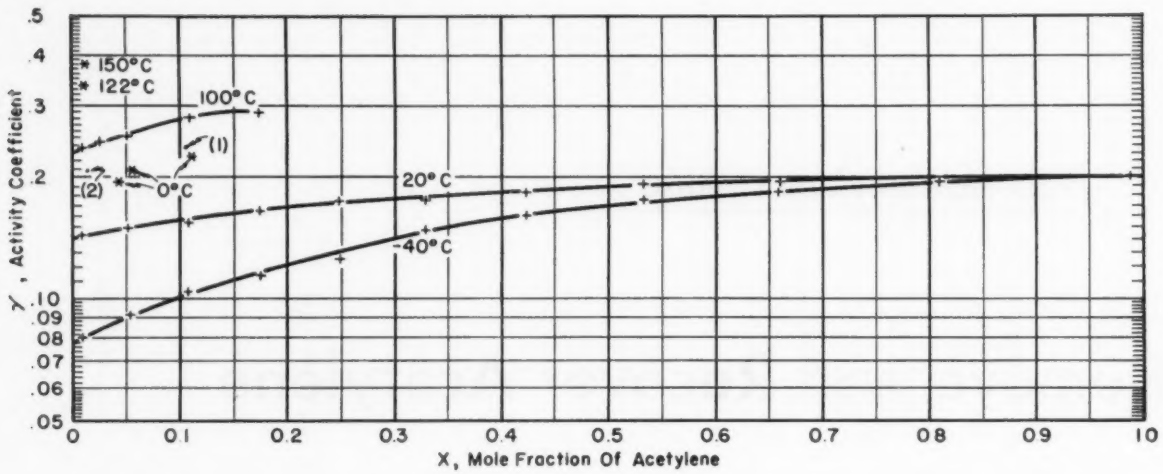

FIGURE 1—Activity coefficients for acetylene in dimethyl formamide. Du Pont data[6] + and Monsanto data * are plotted for the system acetylene-DMF. Monsanto ternary data (acetylene-ethylene-DMF) are plotted for, (1) 0 C, $X(C_2H_4) = 0.256$ and (2) 150 C, $X(C_2H_4) = 0.0715$.

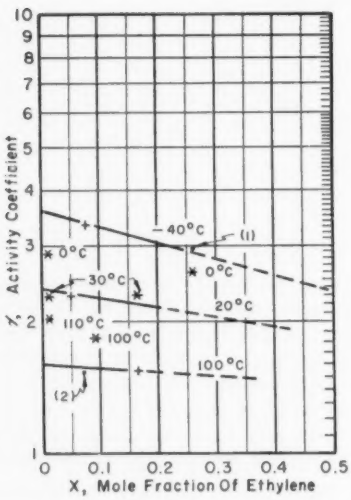

Figure 2—Activity coefficients for ethylene in dimethyl formamide. Du Pont data[6] + and Monsanto data * are plotted for the system ethylene-DMF. Monsanto ternary data (ethylene-acetylene-DMF) are plotted for (1) 0 C, $X(C_2H_4) = 0.1075$ and (2) 146 C, $X(C_2H_4) = 0.0197$.

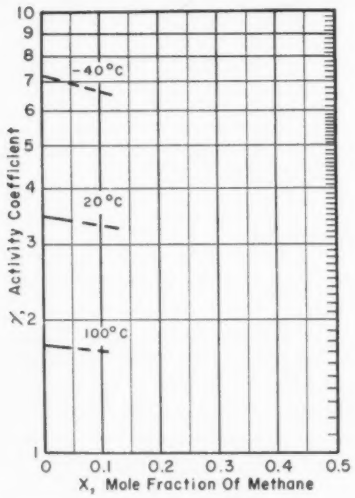

FIGURE 3—Activity coefficients for the system methane-DMF from Du Pont data[6] at —40 C, 20 C and 100 C.

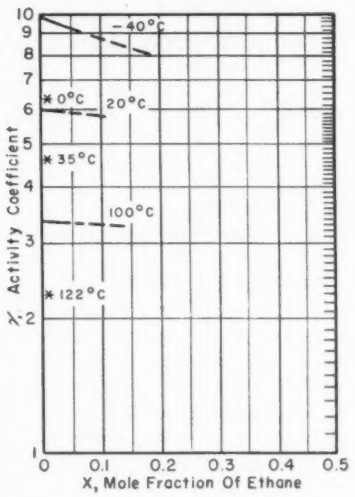

FIGURE 4—Activity coefficients for the system ethane-DMF from Du Pont[6] + and Monsanto * data at —40 C, 0 C, 35 C, 100 C and 122 C.

of acetylene and ethylene in DMF are reported for a temperature range of —40 C. to 100 C. Information is also available on the solubilities of methane and ethane in DMF. Rather complete information on physical properties of DMF is available, also from trade literature.[6]

At the time this work was done, no published information was available on the ternary system, acetylene-ethylene-DMF. Monsanto laboratories ran points on this ternary system using a rocking-bomb method similar to Ipatieff.[2] This data indicated little interference by the introduction of a third component when compared to Monsanto data taken on the binary systems; acetylene-DMF and ethylene-DMF. The limited data obtained in the Monsanto laboratories, in general, complemented published data.[6]

Figures 1 and 2 plot activity coefficients for the binary systems, acetylene-DMF and ethylene-DMF; parameters of temperature are given. Figures 3 and 4 plot similar data for methane and ethane. The Monsanto data are superimposed on the plots which are based on the solubility data reported by Du Pont.[6]

In the design calculations included here, the Du Pont activity coefficients

for acetylene were used. Later (see "Plant Description"), a conclusion is obtained from actual plant performance as to the accuracy of these activity coefficients.

Figure 5 plots $P_o\gamma/\pi$ (equilibrium constant) values versus temperature with liquid concentration and total pressure defined by parameters. These data are from the Du Pont solubility reading.

Figure 6 plots vapor pressure.

Design of System. The method of Souders and Brown[4] was used to set the rough material balance. The more rigid Lewis trial and error method, as described by Sherwood,[3] was used to set the lean oil flow rate and the number of theoretical plates required. Finally, plate to plate, heat and material balance calculations were made.

The sample calculations included guide the reader through the Souders

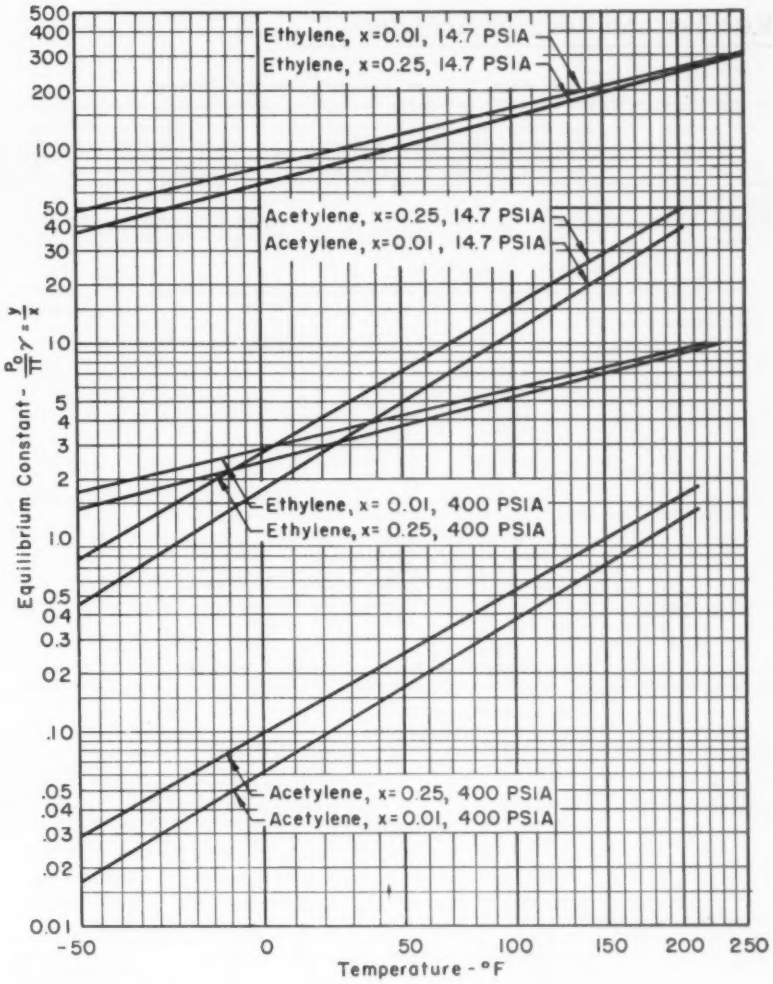
Ethylene, x=0.01, 14.7 PSIA
Ethylene, x=0.25, 14.7 PSIA
Acetylene, x=0.25, 14.7 PSIA
Acetylene, x=0.01, 14.7 PSIA
Ethylene, x= 0.01, 400 PSIA
Ethylene, x= 0.25, 400 PSIA
Acetylene, x= 0.25, 400 PSIA
Acetylene, x= 0.01, 400 PSIA
Equilibrium Constant - $\frac{P_o\gamma}{\pi} = \frac{y}{x}$
Temperature - °F

FIGURE 5 (right)—Equilibrium constants for systems acetylene-DMF and ethylene-DMF with liquid concentration and total pressure defined by parameters from Du Pont[5] solubility readings.

FIGURE 6 (below)—Vapor pressures of DMF, ethane, acetylene, ethylene and methane versus temperature.

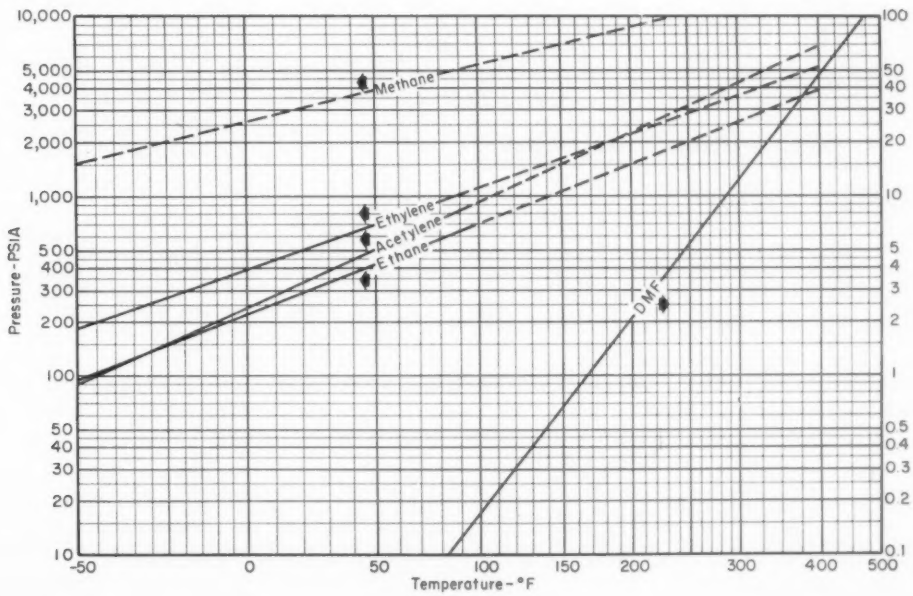

TABLE 1—High Pressure Absorber Material Balance

	Feed from Ethylene Plant moles/hr	Allowable Recycle[2] moles/hr	K′ Equilibrium[1] Constant	$A = \frac{L^2}{VK'}$	Fraction Absorbed 12 Trays (S&B Chart)	Off Gas moles/hr (Design Premise)
Acetylene	0.85	A	0.10	1.6	0.9987	0.0055
Ethylene	100.0	B	3.0	0.0533	0.0533	99.95
Ethane	4.81	C	6.0	0.0267	0.0267	4.81
Methane	2.66	D	41.0	0.0039	0.0039	2.66
	108.32					107.425

[1] Equilibrium constant = $P_o\gamma/\pi$ see figures 1, 2, 3, 4, 5 and 6. For first trial assume following approximate liquid compositions:

	x, mole fraction
Acetylene	0.03
Ethylene	0.25
Ethane	0.01
Methane	0.00
DMF	0.72
	1.00

Temperature = 20°F (=—6.7°C); Pressure = 400 PSIA

[2] From Souders and Brown chart when A for acetylene equals 1.6, 99.87% of acetylene will be absorbed in 12 theoretical plates. This meets desired purity for product ethylene and sets L/V at 0.16.

[3] (0.85 + A) (1 − 0.9987) = 0.0055 , A = 3.41
(100.0 + B) (1 − 0.0533) = 99.95 , B = 5.58
(4.81 + C) (1 − 0.0267) = 4.81 , C = 0.13
(2.66 + D) (1 − 0.0039) = 2.66 , D = 0.01
9.13

TABLE 2—Revised Absorber Material Balance

	Recycle to Absorber		Comment
	moles/hr	mole fraction	
Acetylene	A — 3.41	.374	Since the recycle is compressed from atmospheric to 400 PSI, 37 mole percent acetylene in the stream would be potentially hazardous. To reduce the acetylene concentration in the recycle and to retain control over its concentration we will add an absorption section to the top of the prestripper and set the recycle at 5 mole % acetylene maximum. Thus:
Ethylene	B — 5.58	.612	
Ethane	C — 0.13	.014	
Methane	D — 0.01	....	
	9.13	1.000	A =[(9.13 − 3.41) + A] 0.05; A = 0.30

Revised Absorber Material Balance:

	Feed from Ethylene Plant mole/hr	Recycle mole/hr	Total Vapor Feed, mole/hr	Fraction Absorbed	Off Gas mole/hr	Bottoms to Prestripper mole/hr
Acetylene	0.85	0.30	1.15	0.9987	0.0015	1.15
Ethylene	100.00	5.58	105.58	0.0533	99.95	5.63
Ethane	4.81	0.13	4.94	0.0267	4.81	0.13
Methane	2.66	0.01	2.67	0.0039	2.66	0.01
DMF	.....	...	.....		.....	11.38
	108.32	6.02	114.34[1]		107.42	18.30[1]

[1] L/V = 0.16, L = 18.3

TABLE 3—Atmospheric Flash Calculation

	Bottoms to Prestripper		K′[2] = Po/π @ 0°F 1 atm.	Try V = 0.34 K′V	L = 0.66 K′V + L	x^3 = m.f. /K′V + L	Moles Vapor	Moles Liquid
	moles/hr	m.f.[1]						
Acetylene	1.15	0.0628	1.7	.578	1.238	0.051	0.53	0.62
Ethylene	5.63	0.3080	80	27.2	27.86	0.011	5.50	0.13
Ethane	0.13	0.0071	100	34.0	34.66	....	0.13	....
Methane	0.01	0.0005	1000	340.0	340.66	....	0.01	....
DMF	11.38	0.6216	Nil	0	0.66	0.943	...	11.38
	18.30	1.0000				1.005	6.17	12.13

[1] This is a good check with the liquid composition assumed in setting coefficients in calculations on the high pressure absorber.
[2] Assumed composition of equilibrium liquid is as follows:

	x, mole fraction
Acetylene	0.01
Ethylene	0.01
Ethane	....
Methane	....
DMF	0.98
	1.00

[3] Checks reasonably well with assumed composition.

and Brown calculations. The calculations, using the Du Pont solubility data, are based on actual plant feed compositions and are fairly representative of plant operation. Methods of calculating are covered in the references and are not repeated in detail in the sample calculations.

It is desirable to operate the absorber at as high a pressure and low a temperature as practical, since $P_o\gamma/\pi$ (the equilibrium constant) decreases with a decrease in temperature and an increasure in pressure, and as the equilibrium constant decreases the solvent circulation rate decreases. In this case, absorber operation was 400 psia. This pressure was set by the available pressure of the inlet gas streams, the delivery pressure desired for the product ethylene and the beneficial effect of pressure on absorption. Inlet temperature of 10 F on the DMF solvent was used. This allowed a reasonable DMF circulation rate and fitted in well with the large refrigeration system, designed primarily to accommodate the distillation system for purifying ethylene from the cracked gas.

While it is desirable to operate the absorber at high pressures, it is necessary to operate the pre-stripper and stripper at low pressures. This becomes a requirement as acetylene concentrations are high in this end of the absorption system.

Difficulties and hazards associated with acetylene handling will not be discussed here. For safe handling of acetylene, the reader is referred to the literature.[7]

For this system, acetylene-ethylene, German data[1] indicated a maximum safe concentration of about 15 mole percent acetylene in ethylene at 400 psia. For pure dry acetylene, a maximum safe operating pressure of about 20 psia applies. These maximum pressures and concentrations cited are naturally a function of temperature, vessel dimensions and source of ignition. For safe operation, limits of 5 mole percent acetylene in ethylene gas compressed or handled at 400 psia, and a maximum pressure of 18 psia for pure acetylene produced in the stripping operation was set.

Because acetylene is being handled, it is necessary to operate the prestripper and stripper at low pressures.

About the Author

W. H. Stanton is manager of engineering planning for Monsanto Chemical Co., Texas City. He received a B.S. degree in chemical engineering from Purdue University in 1942 and joined Monsanto the same year. Since then, he has worked primarily as a process engineer in plant design at St. Louis, Springfield, Mass.; Columbia, Tenn.; Marshall, Texas; and Texas City, where he has been since 1951. Stanton has worked in many of Monsanto's larger petrochemical plants and is presently specializing in project evaluation and facilities planning. He is a member of AIChE.

TABLE 4—Atmospheric Absorber Calculation

	Vapor from Flash	Allowable Vapor from Stripping Section[3,4] mole/hr	K'[1] at 20°F 1 atm	$A = \frac{L^{2,5}}{VK'}$	Off Gas Design Premise	Fraction Absorber 5 Trays S&B Chart
Acetylene	0.53	E	2.8	1.0	0.30 (max)	.85
Ethylene	5.50	F	94	0.03	5.58	.03
Ethane	0.13	G	163	0.017	0.13	.017
Methane	0.01	H	1120	....	0.01	0
	6.17				6.02	

[1] For first trial assume following approximate liquid composition:

	x, mole fraction
Acetylene	0.05
Ethylene	0.01
Ethane	...
Methane	...
DMF	0.94
	1.00

[2] From Souders & Brown chart when A for acetylene equals 1.0, 85% of acetylene will be absorbed in 5 theoretical trays. This will hold us well below the maximum of 0.30 specified in the off-gas. Thus L/V equals 2.8.

[3] (0.53 + E) (1 — 0.85) = 0.30, E = 1.47 (max. allowable)
(5.50 + F) (1 — 0.03) = 5.58, F = 0.26
(0.13 + G) (1 — 0.017) = 0.13, G = ...
(0.01 + H) (1 — 0.000) = 0.01, H = ...
1.73

[4] recycle stream is ultimately set by V of 0.38 required in prestripper (See Table V)

[5] V = 6.17 + 0.38 = 6.55, L = 18.3

TABLE 5—Atmospheric Prestripper Calculations

	Liquid from Flash, moles/hr	Liquid from Atm. Abs., moles/hr	K'[1] @ 1 atm, 50°F	$S = \frac{K'^{2}V}{L}$	Fraction Stripper 5 Trays, S&B Chart	Flow to Stripper moles/hr
Acetylene	0.62	0.53	7.0	0.0875	0.0875	4.7[3]
Ethylene	0.13	0.17	120.0	1.5	0.95	0.015
Ethane	....	....	....	.....	.....	.....
Methane	....	....	....	.....	.....	.....
DMF	11.38	17.60	....	.....	.....	28.98
	12.13	18.30				33.7

[1] Assume composition of equilibrium liquid at bottom of column as follows:

	x, mole fraction
Acetylene	0.14
Ethylene	0.01
DMF	0.85
	1.00

[2] From Souders & Brown chart when *S* for ethylene equals 1.5, 95% of ethylene will be stripped in 5 theoretical trays. Thus V/L = 0.0125.

[3] L = 30, V/L = 0.0125, therefore V = 0.38. Since acetylene is the stripping vapor exit liquid must be saturated so vapor can flow up the column. A maximum of 1.47 moles acetylene can be used as V without breaking through the atmospheric absorber. The exit liquid at equilibrium, 1 atm, 50°F, can hold about 0.14 mole fraction acetylene or 4.3 moles acetylene. Thus (4.7—0.94 + 0.09) moles acetylene or 3.85 moles will be introduced as stripping vapor.

It is also necessary to add a low pressure absorber to the system to control the acetylene content of the prestripper recycle gas returning to the high pressure absorber.[5] Figure 7 presents a simplified flow diagram for the system.

Tables 1-6 illustrate the method used in setting the material balance for the high pressure absorber, the low pressure absorber-pre-stripper and the combination of the columns. The balance is arbitrarily based on 100 moles of ethylene feed to the system.

Plant Performance. A plant test was run to determine the approximate activity coefficient for acetylene in DMF solution. No special provisions were made to assure accurate meter readings. The test data are readily subject to 10-20 percent error, but since we were looking for order of magnitude results, it was felt that the plant readings could be used to roughly check the activity coefficient plots.

The gas feed rate to the high pressure absorber was held approximately constant. DMF feed to the column was turned down in a stepwise manner. Overhead samples were taken when the system arrived at equilibrium at the reduced DMF flow rate. The DMF flow rate was reduced from a value double the design rate, with a constant overhead flow at design, to the design rate before acetylene appeared in the overhead. The DMF flow was further reduced to a flow rate 95 percent of design and the overheads approached 50 ppm acetylene; at 90 percent of the DMF design flow rate acetylene in the overhead exceeded 50 ppm. The overhead was analyzed by absoring acetylene in Illsovay reagent and reading the color. The test is accurate to about 1 ppm acetylene in ethylene.

Further plant readings were taken on the atmospheric pre-stripper bottoms. Here the DMF is saturated with acetylene at about 10 C. Again the plant data confirmed the calculations. The bottoms run about 10 mole percent acetylene at this temperature, which agrees well with the predicted value.

From these tests, it has been concluded that the accuracy of the Du Pont data for acetylene in DMF is excellent and that the presence of ethylene in the solution has little effect on acetylene solubility in DMF.

Concerning the ethylene-DMF system, the plant data trend toward confirmation of the physical data as stripping of ethylene from acetylene has presented no problems. Also, by reading a difference in plant meters, it is possible to estimate the ethylene in the rich DMF leaving the high pressure absorber. Plant readings indicate that the ethylene content of the rich

DMF is about 32 mole percent at —13 C. which compares favorably with a calculated value of 33 percent.

Conclusions. Conclusions of this study are: (1) Meeting purity requirements has been no problem; (2) The plotted activity coefficients for acetylene and ethylene, Figures 1, 2 and 5, can be used with assurance in design calculations involving this ternary system.

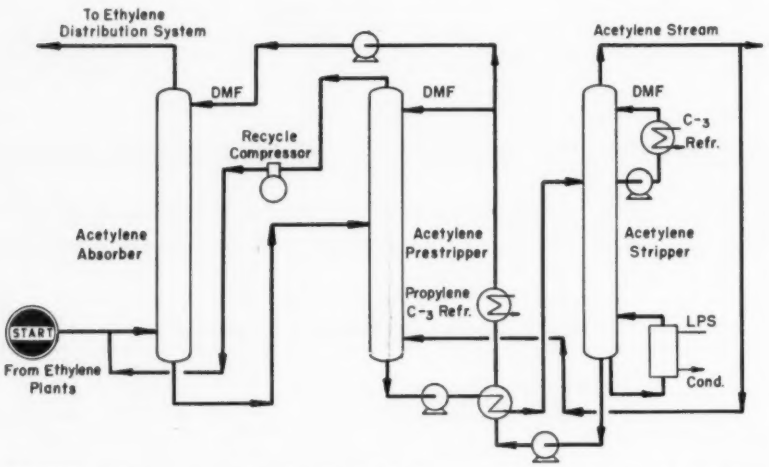

FIGURE 7—Arrangement of equipment for the recovery of acetylene from rich ethylene streams using DMF.

DEFINITION OF TERMS

A = absorption factor = $\frac{L}{K'V}$

K' = equilibrium constant, y/x, $\frac{P_o\gamma}{\pi}$

L = liquid flow, moles/hr

P_o = vapor pressure, PSIA

S = stripping factor = $\frac{VK'}{L}$

V = vapor flow, moles/hr

γ = activity coefficient

π = system pressure, PSIA

DMF = dimethyl formamide

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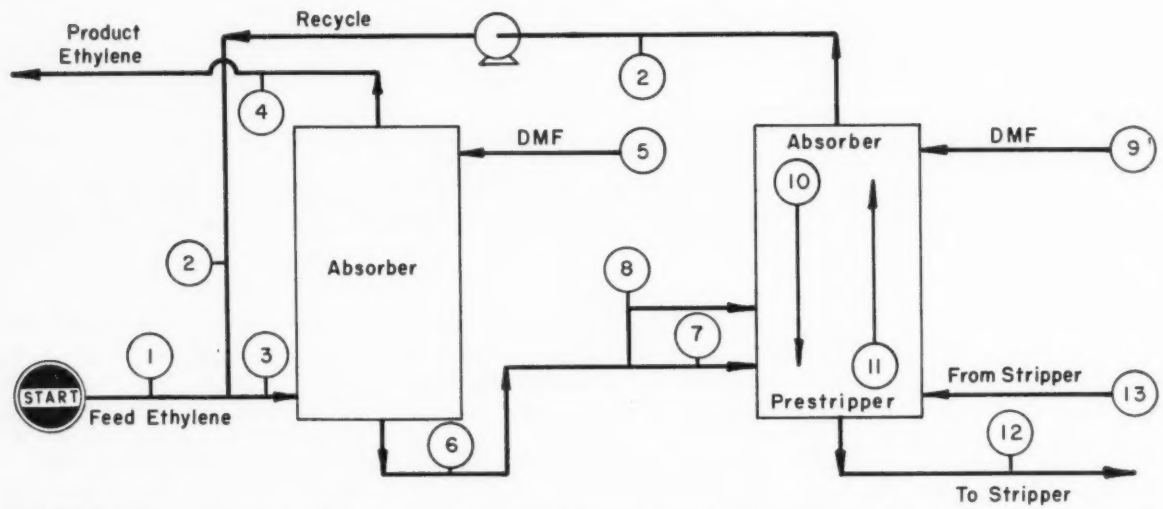

FIGURE 8—These points were used in the calculated material balance around the pressure absorber, flash, atmospheric absorber and prestripper. See Table 6 for numerical data.

TABLE 6—Pressure Absorber, Flash, Atm. Absorber, Prestripper—Calculated Balance

	Mole/Hr												
	1	2	3	4	5	6	7	8	9	10	11	12	13
Acetylene	0.85	0.09	0.94	0.0015	....	0.94	0.52	0.42	....	0.42	0.09	4.7	3.85
Ethylene	100.0	5.62	105.62	99.99	....	5.63	0.13	5.50	....	0.17	0.29	0.01	tr.
Ethane	4.81	0.13	4.94	4.81	....	0.13	....	0.13	....	....	....	....	...
Methane	2.66	0.01	2.67	2.66	....	0.01	....	0.01	....	....	....	....	...
DMF	.....	...	.....	.....	11.38	11.38	11.38	...	17.60	17.60	...	28.98	...
Total	108.32	5.85	114.17	107.46	11.38	18.09	12.03	6.06	17.60	18.19	0.38	33.69	3.85

Consider Uses for Analog Computers

Improved automatic control will make greater use of both digital and analog computers. Here are some specific applications for the analog type

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THERE IS a need for both analog and digital computers in plants of the process industries. Their individual applications are set forth here, and then an examination is made of specific processes where analog in-process computers can be used for yield improvement.

The field of computer process control is now in its early formulative stages where pilot installations and proposed methods of approach have a very important influence upon the future progress of the field. Two general methods of approach are available. Control with a digital computer, and control by analog computer. In this discussion our reference to digital computer refers to the computers currently proposed for process control, incorporating programmable functions, storage logic circuits and digital-analog conversions.

THESE STEPS TOWARD COMPUTER CONTROL

At this early stage in computer application, it would be well to clearly set forth a general approach toward the objectives of computer control for an entire plant. It seems logical to divide this activity into four steps:

Step 1—Determine Process Characteristics. We do not have sufficient knowledge of many of our chemical processes to be able to reduce the optimum operation to mathematical formulae. The dynamics of the processes are often times unknown. The processes which have the greatest potential for economically justifying computer control, are

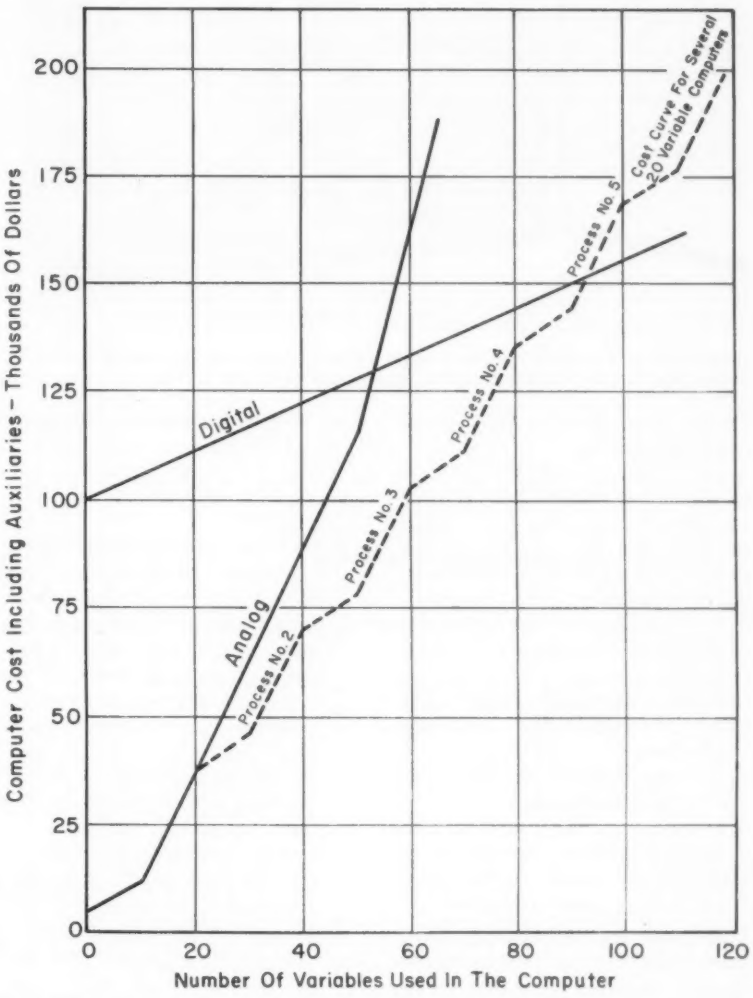

FIGURE 1—Unless there are a large number of variables, the analog is cheaper than a digital computer. These costs include transducers and controlled elements. The solid analog curve applies to one process. If it were assumed several processes exist with 20 variables each, separate analog computers can be used and the cost be lower (dashed line).

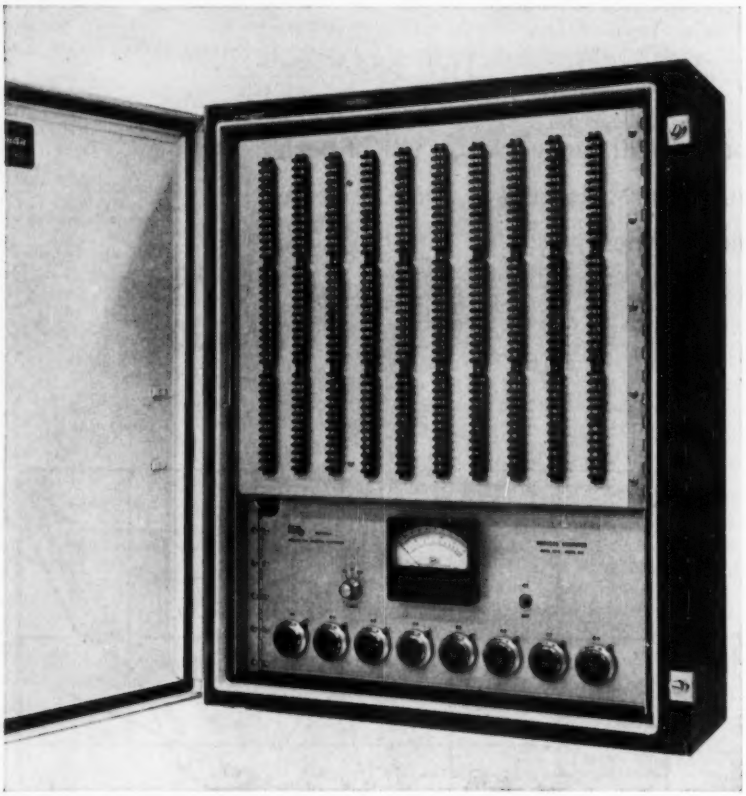

FIGURE 2—The analog computer offers an inexpensive way for plant personnel to gain experience with computer control in plant processes.

usually those that are least understood dynamically.

This, then, is the first step; determine the characteristics of the process. This can be done by dynamic response tests using equipment currently available, or by a digital computer installation on a temporary basis. It also involves the application of some process analyzers for monitoring. Such process test will provide valuable side-benefits other than basic data. Equipment conditions, (scale, leaks, etc.) will be discovered, or a rearrangement of instruments will be proven desirable.

In many processes, such as fractionators, sufficient knowledge already exists to enable application of an optimizing computer control.

Step 2—Install Local Optimizing Controls. Our concept of this phase, departs somewhat from that in the current literature. It is proposed that special purpose analog computers be installed at the process, close by the transmitters and control valves, where the computer can perform those computations required for most efficient operation of the process.

There are many reasons why the analog computer is so well suited for this purpose:

- **Low cost.** The curves of Figure 1 indicate relative costs of the analog computer compared with a digital, based upon the number of points required for optimization. The first cost of a digital computer is upwards of $100,000; of an analog computer, $5,000 and up. It is reasonable to anticipate that 20 or fewer variables will be required in order to optimize the average process. The expected cost for a 20 variable analog computer is seen to be $37,000. More than four 20-point processes can be optimized with the analog approach before the total cost exceeds that for a digital computer.
- **Continuous output.** The control of final elements requires continuous analog signals. No expensive conversion analog-to-digital, and digital-to-analog is required with the analog computer.
- **Extreme reliability.** Analog computers can be constructed entirely of passive and solid state devices (magamps and diodes) such that expected maintenance-free life exceeds 100,000 hours. The photograph of Figure 2 shows the construction of a computer that is already in use.
- **Explosion-proof construction** is normal, since there are no open or moving contacts, high voltages, vacuum tubes or large heat dissipations. Servo operated slidewires, commonly used for multiplication, etc., are replaced.
- **Accuracy.** The accuracy of an analog computer will usually match that of the measurement equipment, which is quite acceptable. There are circuit techniques which can be used to reduce the direct errors of an analog computer.
- **Relative simplicity.** In the case of special purpose computers, the function of the computer is installed by the manufacturer and many hours usually spent for setup are avoided. The analog is more easily understood by mechanics.
- **Computer experience for plant personnel.** The analog computer offers an inexpensive way for plant personnel to gain experience with computer control in plant processes.

Although it would seem from the above reasons that an analog computer is ideal, it is desirable that certain parts of the computation use digital techniques, and there are advantages gained from use of both techniques.

Step 3—Central Logging. By optimizing processes in the field (with an analog computer) it becomes unnecessary to transmit many of the variables involved to the logger. The display of data, for any supervisory control, would be reduced to the essential significant items, and would be useful before the equipment of Step 4 is installed or during shutdown of that computer.

Step 4—Over-all Plant Computer. This step is the addition of

an over-all plant operational computer that would:

- Receive customers' orders together with their priorities.
- Receive maintenance requirements for equipment.
- Receive all cost data.
- Receive production rate data from the processes.

With these data, this unit would:

- Compute the desired scheduling of production.
- Schedule shutdowns of equipment for maintenance.
- Continuously compute the costs per unit of product and indicate process trends.
- Indicate trends of product sales; and, based on the profit ratio, indicate where expansion is required.

There are many reasons for the choice of a digital computer for this function:

- High accuracy
- No limitation on complexity
- Ease of alteration of a program
- Easy expansion
- Most plants already have a digital computer for accounting.

SOME APPLICATIONS OF ANALOG IN-PROCESS COMPUTER CONTROL

The many uses for computer in-process controls fall under four general headings:

1. Operational Aids. Occasions arise each day in a chemical plant where operators must decide the direction and amount to adjust certain setpoints in order to counterbalance a new independent variable. The operator must use his own judgment, based upon his experience. Efficiency would be greatly improved if the operators were given an aid which reduced the number of variables they must consider.

For example, an operational aid computer may make a calculation of the performance factor for a fractionator. One way is shown in Figure 3. The overhead may be a mixture of vapor and gas with some entrainment so that total yield cannot be measured accurately by a vapor-line flow meter, but must be obtained by adding all product flows. This actual yield is ratioed with the theoretical yield which, in this case, is measured as the product of feed analysis and flow rate. This ratio is an indication of the fractionator performance, which the operator attempts to maintain as high as possible. This measurement will respond to sudden feed changes, and indicate the need for alterations to the column control setpoints. In this case, it is assumed that the column is designed with sufficient plates to enable us to assume the product purity level. However, where this is in doubt, the analyzer can be time shared with the output product to measure product purity as well as input composition. With this additional information the reflux ratio could be controlled to maintain constant product purity. The performance measurement would then be significant.

2. Optimizing Processes. At this time, the greatest justification for computer control of processes lies in the optimizing of processes. The computer obtains data from transducers and operates upon this information according to known relationships. Equations, relating the optimum value for each controlled variable to other measured variables, must be simulated and solved simultaneously to obtain optimum settings. These outputs then reposition the setpoints of controllers, and the best performance of the process is assured.

A computer can optimize a process by providing "feedback" or "feed-forward" information. In the case of the former, the output variables of the process are measured

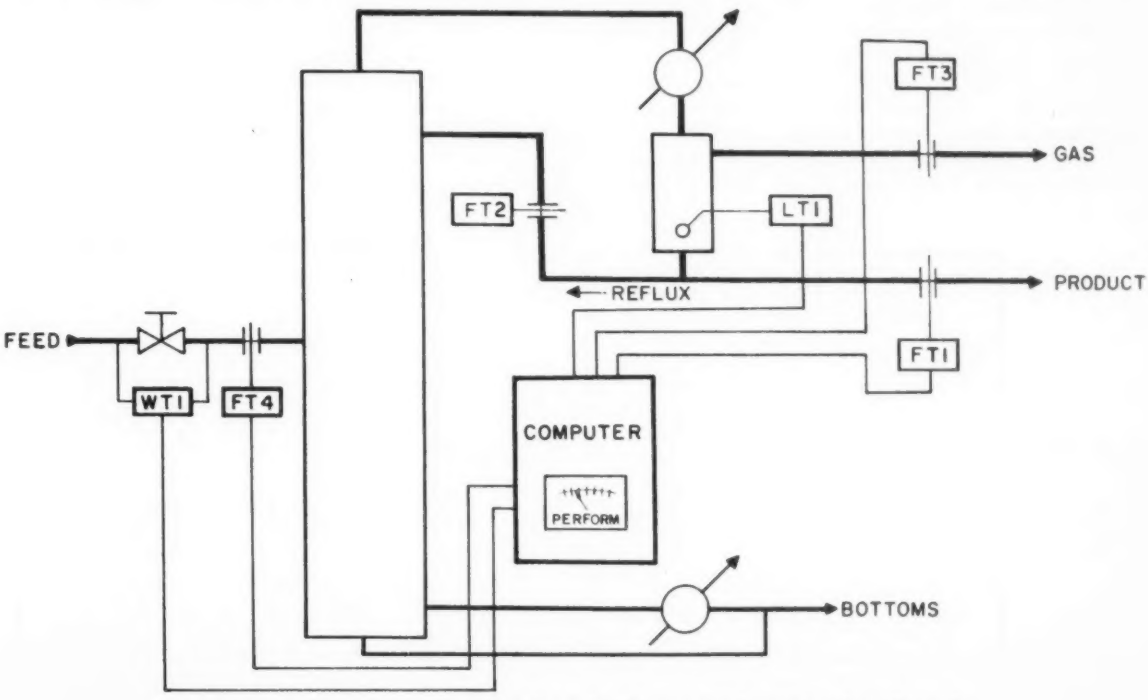

FIGURE 3—The performance factor for a fractionator can be computed continuously.

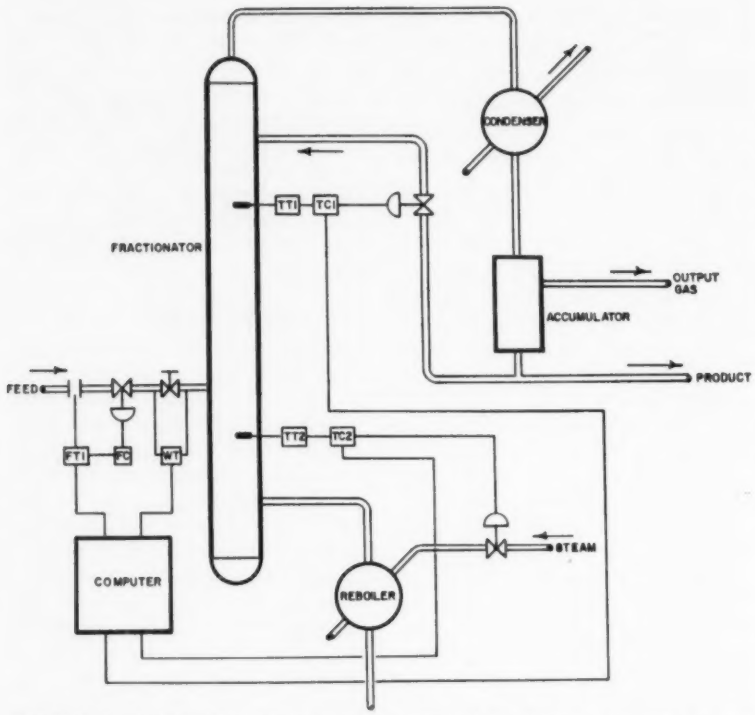

FIGURE 4—A distillation column may be controlled by placing a computer on the input feed for composition analysis.

and, together with other information, generate signals to modulate certain controlled variables in the process that maintain optimum performance. In the case of feed-forward, the operation of the process is predicted in the computer, and the variables are modulated to deliver the desired product at the desired rate although no measurement need be taken of this output. This scheme has an advantage for processes that are inherently stable or that have long time constants.

A *feed-forward* type of computation is shown in Figure 4. A distillation column is controlled in the usual fashion,[2] except that a computer has been placed in the input feed for composition analysis. It is well known that the principal cause of off-standard performance from a column results from changes in the feed rate or composition. In fact, information as shown in the graph of Figure 5 can usually be plotted, relating output to input feed composition for particular product purity levels. If these feed analysis changes are measured, the output from the column can be maintained by adjustments in the process variables according to the known relations. Here, the reflux ratio and the reboiler temperature are adjusted according to these graphs simulated in the computer. In this case, previous experiments determined the relationship between T_1 and the feed composition and T_2 and feed composition for CONSTANT PURITY OUTPUT.[5]

It is also noteworthy that the feed analysis does not need to be a continuous measurement, but may be periodic, as provided by the chromatograph. A memory circuit in the computer stores the information, making it available as needed. Modulation of the controlled elements occurs continuously.

The distillation column control of Figure 4 is an example of the value of the feed-forward principle, since the time constant of the column is so great that feed-back control must be indirect. Other processes suited to the feed-forward technique are batch processes, and reactions where it is not practical to measure the output because of the type of measurement, or inaccessibility of the stream for measurement.

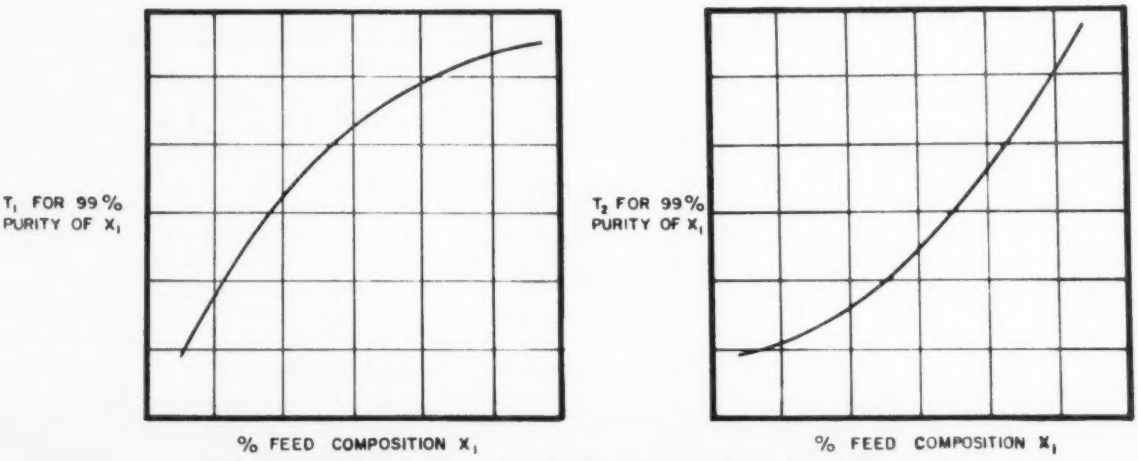

FIGURE 5—Product purity can be related to the composition of the feed.

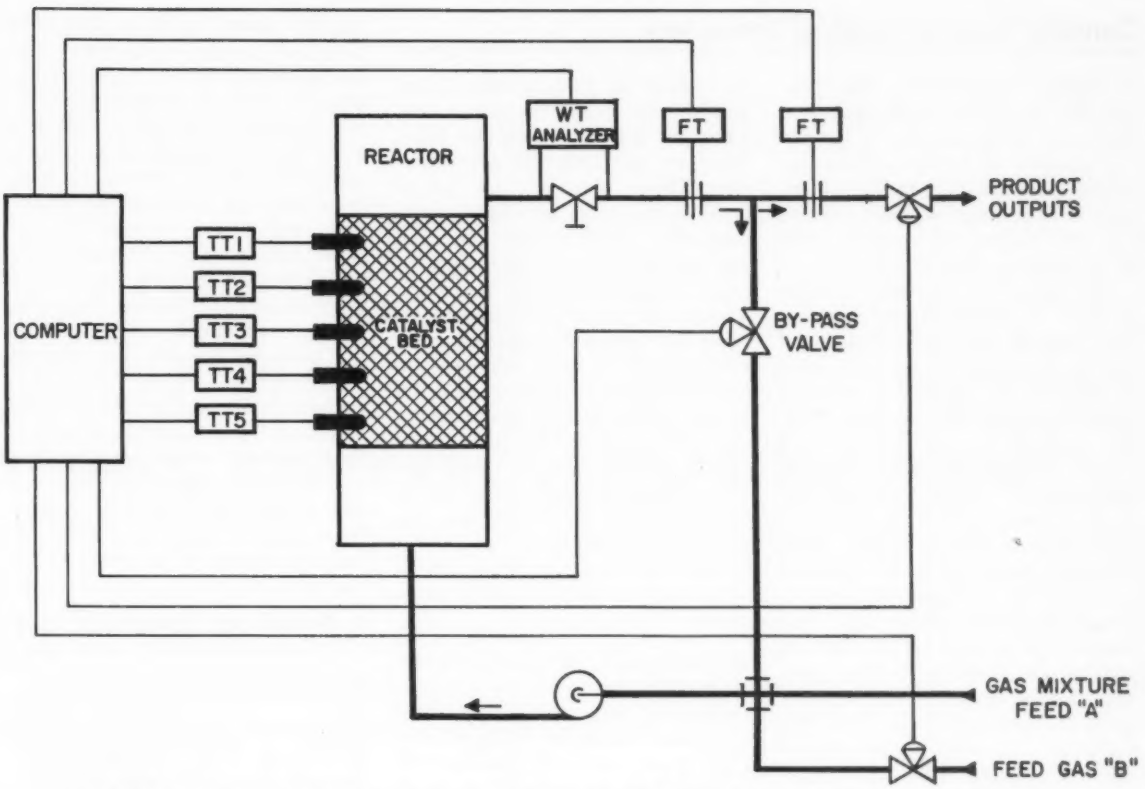

FIGURE 6—A computer can determine how much gas must be bypassed in order to achieve product purity.

In the application shown in Figure 4, composition analysis changes will be immediately registered by the computer. It is, of course, not desirable to alter the settings of TC-1 and 2, until a time interval has elapsed. This time interval can be set into the computer, and can be set at different amounts for different outputs. It should be noted that this control system is designed to work with the standard control instruments to trim setpoints and obtain the last few percent in yield, rather than act as a basic controller.

The *feedback technique* applies to processes where the interrelationship of variables is complex and a process' outputs can be analyzed in order to determine the setting of controlled variables to maintain optimum output. An example of this technique is a catalytic reaction as shown in Figure 6. Gases are introduced to this catalytic reactor where they combine to form a vapor of the desired product, leaving an excess of one gas. The catalyst operates exothermally, and is depleted with use, especially

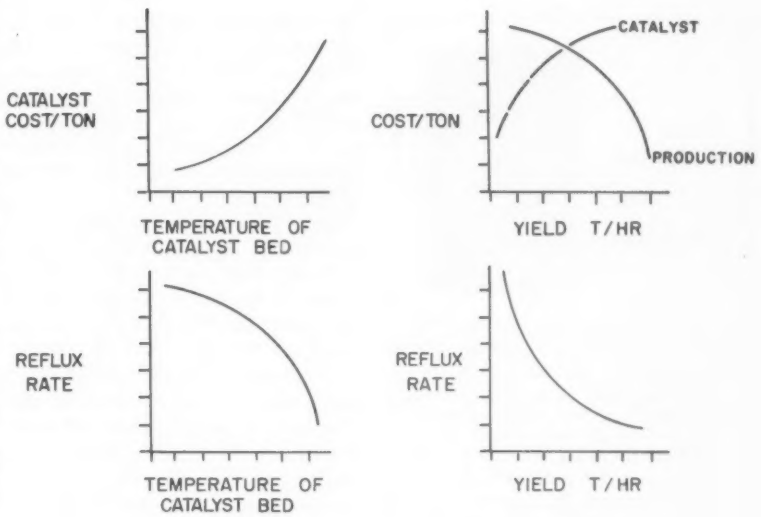

FIGURE 7—Several relations are needed to obtain optimum product cost.

at higher temperatures. The temperature at a point in the catalyst is indicative of the amount of gas being reacted. A bypass around the reactor allows cooling of the catalyst bed. It is practical to modulate the gas feed valves, the bypass valve, or the product take-off rate.

The objective is to produce quality product at minimum cost per ton. The catalyst bed temperature will require bypassing of gas, but doing so reduces the quantity of product from the process. On the other hand, the product cost per ton increases rapidly at high operating temperatures because of rapid consumption of the catalyst as well as the downtime costs for replenishment. These relationships are not linear and have been plotted in Figure 7. It is apparent that unit product cost is a function of catalyst temperature as well as rate of gas feed. This equation can be differentiated with respect to these two basic controlled variables. The final picture of cost per ton, appears in the upper right hand graph of Figure 7. By tracing a point through these graphs, the corresponding catalyst cost can be plotted together with the production cost. The minimum total cost per ton is then the point of intersection. If the parameters remained constant, all setpoints could be fixed. They do not, and this point may vary. Hence equations are formulated in the computer relating these parameters which are then combined and solved using the two basic variables, temperature and feed rate. Values for input gas ratio, bypass ratio, and output flow rate can then be obtained from the computer to maintain optimum product cost. Of course, such a process could be set up so that a certain constant flow rate of product was maintained and the optimum arrangements could be computed for lowest cost per ton under these conditions.

The techniques used in this example can be applied to many processes.[4]

3. Integrated Computer Processes. By considering the incorporation of a computer in the original mechanical design of a process, many new process configurations can be conceived. It is possible to eliminate certain operations in a process merely by carrying on certain reactions to predicted degrees of completion, as called for by the computer. Intermediate reaction or storage vessels may thus be avoided. In other applications, the need for carrying out reactions in an overabundance of one component will be eliminated and the equipment required to separate the product from the unreacted components will be unnecessary.

Extremely non-linear process reactions may be controlled easily and efficiently by incorporating a simulation of the process in the control loop such that linear control instruments can be used.

There are reactions that have never been carried on outside the laboratory because of the difficulty of control, but which now become practical with in-process computation. For example, a pipeline reactor requires continuous monitoring and control for steady efficient operation. Such processes, in a plant, will reply upon the dependability of the computer. Modern analog computers warrant this kind of reliance.

The construction of a modern process computer can provide a reliability almost equal to that of a piece of process equipment. The low performance electronic components, such as vacuum tubes, relay contacts and servo slidewires have been eliminated in the latest computers. Their functions have been replaced by magnetic amplifiers, and diodes, or special transistor circuits. The slidewires have been replaced in their function of multiplication or division, by a logarithm technique. In this procedure, the incoming signal is converted to its logarithm, to which other such signals can be added (for mutliplication) or substracted (for division). Such a system is completely passive and inherently suitable for explosion-proof areas. No maintenance is required for the life of the magnetic amplifiers. The drift is insignificant.

4. Design and Educational Uses. At an ever-increasing pace, engineers are using simulations of processes to determine preferred designs. In one hour with the computer, it is possible to obtain data that would have taken several days at the plant.

Prices of such computers are low enough to warrant this approach where the process is one requiring a sizable design effort.

THE NEXT STEP: ANALYSIS FOR APPLICATION

The next step toward improved automatic control is:

1. Analyze existing processes to see if a computation of measured variables would enable optimization of the process for maximum yield of product and
2. Inspect new process expansions for the potential application of in-process computers.

These procedures will be a start toward computer control in any plant. When experience has been gained with one or two units, many further justifiable potential applications undoubtedly will beckon.

Original presentation was before the Instrument-Automation Conference of the Instrument Society of America, Philadelphia, September, 1958.

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About the Author

John F. Pink has a degree in electrical engineering from the University of Manitoba. He served as an engineering officer in the Canadian Navy during World War II, and joined E. I. duPont de Nemours & Co. in 1945 where he worked in industrial instrument development and application until 1956. He received a M.S. degree in electrical engineering from the University of Pennsylvania in 1954, and joined Southwestern Industrial Electronics Corp., Houston, in 1957 as a senior engineer. A member of AIEE, ISA and NSPE, Pink is a registered professional engineer.

Treating Improves Cat Cracker Feed

Acid treating removes nitrogen and other catalyst poisons from the charge to catalytic cracking to give better gasoline yields

G. J. Samuelson and William Woelflin
Petrolite Corporation
St. Louis, Mo.

NITROGEN COMPOUNDS, especially those characterized as nitrogen bases, in petroleum hydrocarbons are recognized as catalyst poisons with detrimental effect on catalyst performance in various refining processes. Here are data on acid treatment of various charge stocks for the removal of nitrogen compounds together with relevant data showing the effect of such removal on the results of catalytic processing.

The acid-treating data were developed in the research laboratories of the Petrolite Corporation on charge stocks supplied through the cooperation of various refiners. Catalytic processing data were supplied by these same refiners after pilot-plant processing of the treated stocks.

Nitrogen bases are considered temporary, but none the less serious, poisons. Indeed, there is evidence that all nitrogen compounds, whether basic or non-basic, are damaging in certain refinery catalytic processes and should be removed.

Generally, the ratio of basic to total nitrogen in crude oil and its fractions is about 0.3.[5,8] A notable exception appears to be coker gasoline, in which ratios as high as 0.8 and 0.9 have been experienced. Usually the basic compounds can readily be removed from distillates, with only slight loss of charge stock, by acid treatment. Removal of the non-basic compositions is likewise possible in specific instances, but generally requires more drastic acid treatment with consequent greater loss of charge stock.

Modern hydrogen refining processes have in many cases provided an effective, though complex and costly, solution to the removal of the nitrogen as well as the sulfur content. Where the simple acid-treating process achieves

These other articles telling of Nitrogen Removal by Acid Treating appeared in PETROLEUM REFINER: Treating Ousts Nitrogen," vol. 36, no. 9 (Sept., 1957), pp 231-232. "Better Yields After Nitrogen Removal," vol. 37, no. 3 (March, 1958), pp 197-200.

the required nitrogen reduction its use is economically attractive.

The Charge is Treated. The data of Table 1 identify the several charge stocks considered in this study, indicate the type of pre-cracking treatment given them and show the pertinent results of such treatment. In general this treatment consisted of continuous pilot-plant processing in the acid and water-wash stages, each stage involving rapid electrostatic precipitation of the finely-dispersed treating agent to the lowest value consistent with the conditions imposed. The charge stocks were derived from California crudes with the exception of Sample A, which was from a Mid-Continent crude.

Cracking Tells The Story. Table 2 lists the various raw and treated samples with additional data resulting from the acid pretreatment and shows the results of pilot-plant catalytic cracking of raw and pretreated oils. Nitrogen base values were determined by a method[7] involving analytical extraction of all basic material by repeated acid treatment, neutralization and solvent extraction of the nitrogen bases from the acid extract, and electrometric titration of the isolated bases. An arbitrary average molecular weight of 300 is assigned to these nitrogen bases for purposes of computation. Nitrogen values were determined by the Kjeldahl method.

Improvement Shown. The data of Table 2 do not permit comparison of cracking results between differently lettered samples because the conditions of cracking (type of catalyst, type of pilot cracking plant, space rate, carbon laydown, etc.,) vary. However, for the raw and acid pretreated charge stocks under a given lettered sample, these conditions have been chosen for comparability.

Removal of basic nitrogen exerts an appreciable benefit upon cracking performance—a benefit roughly proportional to the extent of base removal. Without exception, improvement in gasoline yield, conversion or carbon laydown resulted. The economic significance of this improvement for a specific installation must be evaluated on the basis of many complex factors and in the light of pilot treating results on the subject oils. Usually the first approach to evaluation would be either from the standpoint of increased conversion at constant carbon laydown or of decreased laydown at constant conversion, depending on which factors limit the capacity of the unit.

Samples B, C, D, and G, reflecting constant carbon laydown for raw and pretreated stocks, show the effect of base removal in increasing conversion and total gasoline. On the other hand, samples A, E, and F, at constant conversion, indicate the reduction in carbon which may result. In any evaluation these benefits must, of course, be considered in relation to the treating losses, which may be several percent of the charge stock, depending on acid dosage.

One of the tests of Table 2 (Sample A) is of theoretical interest in that it was an attempt to show the effect on cracking of adding nitrogen base to a stock from which the natural bases had been removed. Quinoline was added in amount sufficient to restore the total nitrogen content to that of the original raw sample. The tabulated data show a significant drop in C_4 volume on cracking this sample as

TREATING REMOVES A NUMBER OF CATALYST POISONS

The type and extent of nitrogen compound distribution in petroleum have been suggested by various investigators.[2,3,5,6,7,8] Basic compounds are usually thought to be of pyridine- or quinoline-like structure while the non-basic components may be derivatives of pyrrole, indole, or carbazole. Comprehensive knowledge of the subject is lacking, and the need in the petroleum industry for extensive data is apparent in the organization in 1954 of a special American Petroleum Institute research project[1] to study nitrogen occurrence.

Other potential catalyst poisons in petroleum are certain of the light and heavy metals. Of these the light metals present no serious problem since their compounds, being generally water-soluble, can be removed effectively by simple washing procedures. Vanadium, copper, nickel, iron, and others are quite difficult to remove because of the insolubility of their salts or organic complexes in most usable reagents. We are not concerned here with the problem of metals except to note that some of these are susceptible to removal by the acid treatment used to remove nitrogen bases. Thus, arsenic and lead, the almost complete absence of which (less than 5 parts per billion) is usually considered necessary for satisfactory platinum catalyst performance, can be removed from many stocks with spent alkylation acid or other strong sulfuric acid. Vanadium, nickel, and iron are not readily removed by acid treatment of most charge stocks; the data on removal of these metals which were obtained in this study indicate approximately 50 percent reduction on some oils and negligible removal on others.

TABLE 1—Treating Data

Sample Code	Description	ACID TREATING				WATER WASHING			FINISHED OIL		
		Acid	Lb/Bbl	Temp. °F.	Vol. % Sludge in Treated Oil	Number Washes	Vol. % of Oil Charge	Temp. °F.	(Vol. %) Suspended Matter	Acid No. to pH7	Yield (% of Charge)
A	Vacuum Gas Oil	Spent Alkylation	5	200	<0.2	2	5	200	<0.2	0.35	97
B	Gas Oil	Spent Alkylation	5	200	<0.1	2	5	200	<0.4	0.14	95
		Spent Alkylation	10	205	<0.1	2	5	200	<0.4	0.35	93.7
C	Gas Oil	Spent Alkylation	2	200	<0.01	1	5	200	<0.01	0.36	98.7
		Spent Alkylation	4	200	<0.01	1	5	200	<0.01	0.26	97.1
D	Heavy Gas Oil	40% H_2SO_4	2	200	0.12	1	2	200	0.06	0.10	98.4
E	Gas Oil	Spent Alkylation	5	150	0.01	1	10	165	0.05	0.11	95.7
F & G	Gas Oil	Spent Alkylation	5	165	0.01	1	10	150	0.05	0.05	95.7
H	Gas Oil	35% H_2SO_4	4.6	190	0.15	1	4	200	0.26	0.10	96.4
I	Gas Oil	40% H_2SO_4	1.8	190	0.10	1	2	185	0.01	0.09	98.4
J	Coker Gas Oil	Spent Alkylation	3	150	0.01	0	0	...	...	0.28	96.3
		Spent Alkylation	6	155	0.18	0	0	...	...	0.32	95.1
		Spent Alkylation	10	155	0.14	0	0	...	...	0.24	93.1

About the Authors

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TABLE 2—Cracking Data

Sample Code	Pretreatment (Lb. Acid/Bbl.)	Gravity (°API)	Nitrogen Bases (%)	Base Removal (%)	Nitrogen Total (%)	Conversion (%)	Carbon (wt. %)	Total Gasoline (Vol. %)	C_4 (Vol. %)
A	Raw	23.0	0.58	...	0.18	53.0	5.6	43.0	8.5
	5	24.6	0.02	96.5	0.12	53.0	4.0	45.2	9.4
	Special*	24.6	0.57	...	0.18	53.0	4.0	45.0	8.5
B	Raw	17.9	1.40	...	0.44	42.0	5.0	37.0	4.6
	5	19.7	0.07	95.2	0.27	56.6	5.0	52.3	11.0
	10	19.3	0.01	99.6	0.21	60.0	5.0	55.4	13.5
C	Raw	21.3	1.38	...	0.35	49.8	5.0	44.4	8.8
	2	21.5	0.73	47.2	0.30	53.0	5.0	47.2	9.9
	4	21.6	0.14	89.6	0.28	58.4	5.0	52.5	13.7
D	Raw	21.8	1.28	...	...	48.8	5.0	44.6	6.2
	2	22.0	0.29	77.3	...	53.5	5.0	50.2	9.5
E	Raw	26.0	1.14	...	...	60.0	8.8	34.0	14.0
	5	26.3	0.19	83.4	...	60.0	6.3	36.5	14.0
F	Raw	26.0	1.14	...	...	50.0	5.6	33.2	9.8
	5	26.3	0.19	83.4	...	50.0	4.0	35.7	9.8
G	Raw	26.0	1.14	...	...	51.5	6.0	33.5	10.4
	5	26.3	0.19	83.4	...	59.0	6.0	36.5	13.7
H	Raw	22.4	1.16	...	...	32.5	4.0	23.8	4.9
	4.6	22.9	0.12	90.0	...	36.6	3.6	27.8	5.9
I	Raw	24.2	0.93	...	...	27.6	2.3	21.2	4.6
	1.8	24.7	0.09	90.0	...	32.5	2.2	26.6	5.5
J	Raw	21.2	1.44	...	0.37	56.7	5.6	35.9	9.3
	3	21.4	0.15	89.6	0.24	58.9	5.8	37.3	14.5
	6	21.6	0.016	98.8	0.19	62.2	5.6	38.9	5.3
	10	22.0	0.009	99.4	0.14	63.0	5.7	36.5	9.7

* Same as pretreated stock plus 0.06% nitrogen (as quinoline) added.

compared with that which was base free; indeed, the C_4 value is identical with that for the raw sample with its natural base content.

Other data for the samples under A (not listed in Table 2) show also an interesting comparison of these three from the standpoint of conversion at constant space rate under otherwise comparable conditions of cracking. The conversion percentages were: Raw—48.0; Pretreated—56.3; Pretreated with quinoline added—51.3. Although these data are limited, and the comparability of quinoline with the naturally-occurring nitrogen bases might be questioned, the results shown in this series support the thesis that bases are damaging.

The data given in the tables include the results on acid pretreated samples prepared in our laboratories upon which cracking data are available. Many more runs on a variety of stocks under widely different conditions have been made to evaluate the electrical precipitation and related treating aspects of the base removal pretreatment. No unusually difficult problems appear to be associated with the acid and washing steps.

In general, the acid treating and precipitation step is very efficient; nevertheless, appreciable dissolved and suspended acidity remains in the oil from this stage. Water washing stages remove this effectively but, because of possible corrosion problems, the question has arisen as to whether washing might be replaced by gaseous ammonia injection to neutralize the acidic material before cracking. This seems feasible from such data as are available; but the effect of the acid-ammonia components in plugging or corroding the furnace tubes at high temperatures has not yet been determined.

Corrosion in the acid treating stage is not serious; but at the washing stage the dilute acid encountered is more corrosive. Proper selection of materials of construction would solve this problem, however.

Acid processing of hydrocarbons has always posed the problem of disposal of the sludges, and substitutes for acid treating are constantly sought. Because it achieves chemical refining results which are economical and sometimes unique it is frequently preferred, and modern methods of sludge regeneration have in many cases solved the disposal problem. In the processing under consideration the alkylation acid sludge formed in the acid stage has been found to be remarkably free of entrained oil, uniform in composition, and fluid in character at the elevated temperatures. Its low-temperature consistency depends, of course, upon the quantity of acid used and the stock treated. In limited testing the worst of these sludges has been found amenable to resolution with ammonia into useful by-products, a neutral oil and concentrated ammonium sulfate solution, by a method similar to that described by Bragg.[4]

ACKNOWLEDGMENT

The authors are indebted to the several people within their own organization whose work on various aspects of the project provided valuable data for this paper; and to the refining companies which provided the charge stocks and made available the pilot cracking data.

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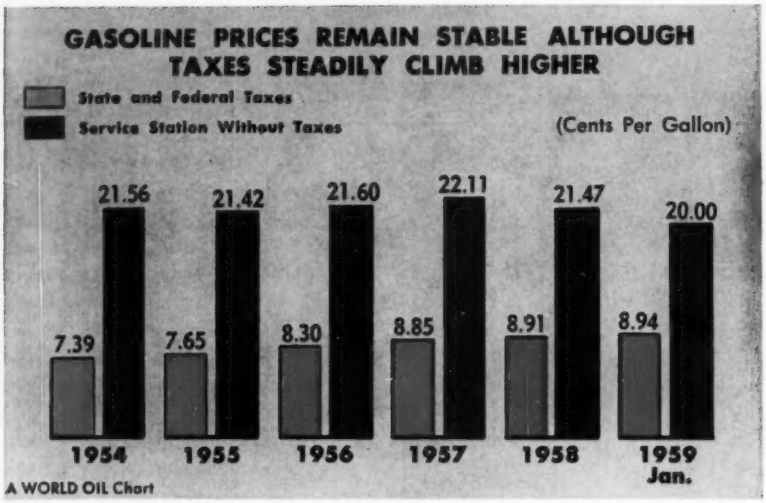


U. S. Average Prices of Gasoline in 50 Cities, by Years

Source: The Texas Co., via API.
(Cents Per Gallon)

YEAR	Dealer's Net	Service Sta. Excl. Tax	State and Local Tax	Federal Tax	Service Sta. Incl. Tax
1918	....	25.12	0.00	....	25.12
1919	....	25.41	0.06	....	25.47
1920	....	29.74	0.09	....	29.83
1921	....	26.11	0.20	....	26.31
1922	....	24.82	0.38	....	25.20
1923	....	21.06	0.91	....	21.97
1924	....	19.46	1.48	....	20.94
1925	....	20.09	2.11	....	22.20
1926	17.44	20.97	2.41	....	23.38
1927	15.00	18.29	2.80	....	21.09
1928	14.83	17.90	3.04	....	20.94
1929	14.58	17.92	3.50	....	21.42
1930	12.48	16.17	3.78	....	19.95
1931	9.65	12.98	4.00	....	16.98
1932	10.08	13.30	4.13	0.50	17.93
1933	9.42	12.41	4.16	1.25	17.82
1934	9.81	13.64	4.21	1.00	18.85
1935	9.73	13.55	4.29	1.00	18.84
1936	10.21	14.10	4.35	1.00	19.45
1937	10.53	14.59	4.40	1.00	19.99
1938	10.04	14.07	4.44	1.00	19.51
1939	9.58	13.31	4.44	1.00	18.75
1940	9.08	12.75	4.41	1.25	18.41
1941	9.49	13.30	4.43	1.50	19.23
1942	10.44	14.46	4.47	1.50	20.43
1943	10.45	14.56	4.47	1.50	20.53
1944	10.49	14.62	4.47	1.50	20.59
1945	10.33	14.48	4.52	1.50	20.50
1946	10.40	14.69	4.58	1.50	20.77
1947	12.33	16.93	4.68	1.50	23.11
1948	14.55	19.54	4.84	1.50	25.88
1949	15.05	20.27	5.02	1.50	26.79
1950	15.10	20.08	5.18	1.50	26.76
1951	15.33	20.31	5.25	1.59	27.15
1952	15.27	20.24	5.32	2.00	27.56
1953	15.95	21.28	5.41	2.00	28.69
1954	16.19	21.56	5.39	2.00	28.95
1955	16.18	21.42	5.65	2.00	29.07
1956	16.33	21.60	5.80	2.50	29.90
1957	16.69	22.11	5.85	3.00	30.96
1958 Est.	16.22	21.47	5.91	3.00	30.38
1959 Jan.	14.85	20.00	5.94	3.00	28.94

Gasoline Costs Are Down

INTENSE U.S. marketing competition continues to produce a soft price outlook for gasoline, despite improvement in stocks during 1958. Also, the threat of increased federal and state taxes on gasoline has dimmed the outlook.

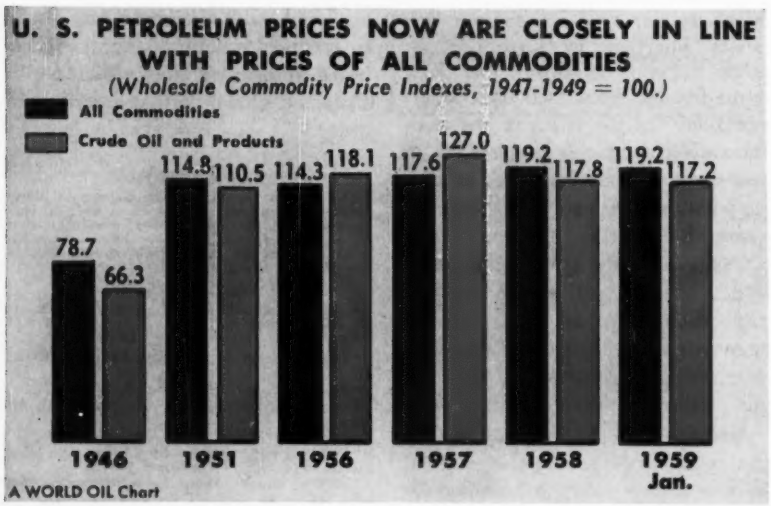
According to January, 1959, estimates, state and federal gasoline taxes were up .03 cents per gallon to 8.94 cents, continuing an upward trend that has resulted in a tax increase every year since 1950. Retail gasoline prices exclusive of taxes dropped to an estimated 20 cents in January, the lowest price level since 1948.

Oil Price Index Under All Commodities

FOR THE SECOND year in a row, the wholesale price index of crude and products has remained below the index for all commodities. The estimate for crude and products was 117.2 percent of the 1947-49 level in late January, .6 of a point below the 1958 percentage of 117.8.

While the index for all oils has been declining since 1957, wholesale prices of all commodities leveled off in January at 119.2, same as the 1958 index, after a five-year upward trend.

In 1959 oil prices likely will stay closely in line with other prices.



Index of Wholesale Prices

(All Commodities vs. Crude Petroleum and Petroleum Products.)

Source: U. S. Bureau of Labor Statistics.
1947-1949 = 100

Year	All Commodities	Crude Oil & Products	Year	All Commodities	Crude Oil	Pet. Products	Crude Oil & Products
1926	65.0	98.1	1944	67.6	.....	.....	62.7
1927	62.0	71.3	1945	68.8	.....	.....	62.4
1928	62.9	70.6					
1929	61.9	69.9	1946	78.7	....	....	66.3
1930	56.1	60.4	1947	96.4	81.6	89.6	88.2
			1948	104.4	109.9	112.1	111.7
1931	47.4	38.7	1949	99.2	108.5	98.3	100.1
1932	42.1	44.5	1950	103.1	108.4	102.8	103.7
1933	42.8	40.2					
1934	48.7	49.5	1951	114.8	109.0	110.1	110.5
1935	52.0	50.3	1952	111.6	109.0	109.2	109.3
			1953	110.0	117.0	111.9	112.7
1936	52.5	56.2	1954	110.3	120.3	109.4	110.8
1937	56.1	59.3	1955	110.7	120.5	111.2	112.8
1938	51.1	54.9					
1939	50.1	51.3	1956	114.3	121.1	117.5	118.1
1940	51.1	49.1	1957	117.6	133.6	125.8	127.0
			1958	119.2	133.4	114.8	117.8
1941	56.8	56.0	1959	....	....	....	....
1942	64.2	58.7	Jan.	119.2	133.3	114.4	117.2
1943	67.0	61.4					

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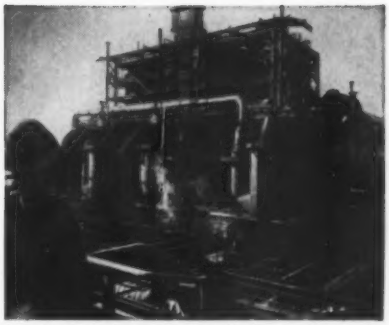

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Here's a quick run-down on what's presented in this month's non-technical sections. These departments will keep you right up-to-date with what's new and different in this rapidly changing oil industry.

Maintenance Tools

A special section in this month's "New Equipment" department will feature 14 of the more significant maintenance tools presented in 1958. You will want to read about these real labor and money savers. In addition to this feature, you will find PETROLEUM REFINER's usual complete new equipment rundown on the latest and best implements for your plant.

Keep Going to Page 320

Easier Tube Removal

Like to cut exchanger tube removal time? Then you'll want to read how a stud bolt, three nuts and a file combine with a plastic plug and tube roller to make the job faster and easier. It's all there in this month's "How To Do It" section along with other valuable tips.

Keep Going to Page 228

New Calendar

Your PETROLEUM REFINER Meeting Calendar has undergone a complete change in this issue. You'll find an entirely new presentation of this valuable feature. The type is larger and Society names are popped in bold face to give you a truly easy-to-read tabulation of coming meetings. See for yourself!

Keep Going to Page 274

Control System Engineering

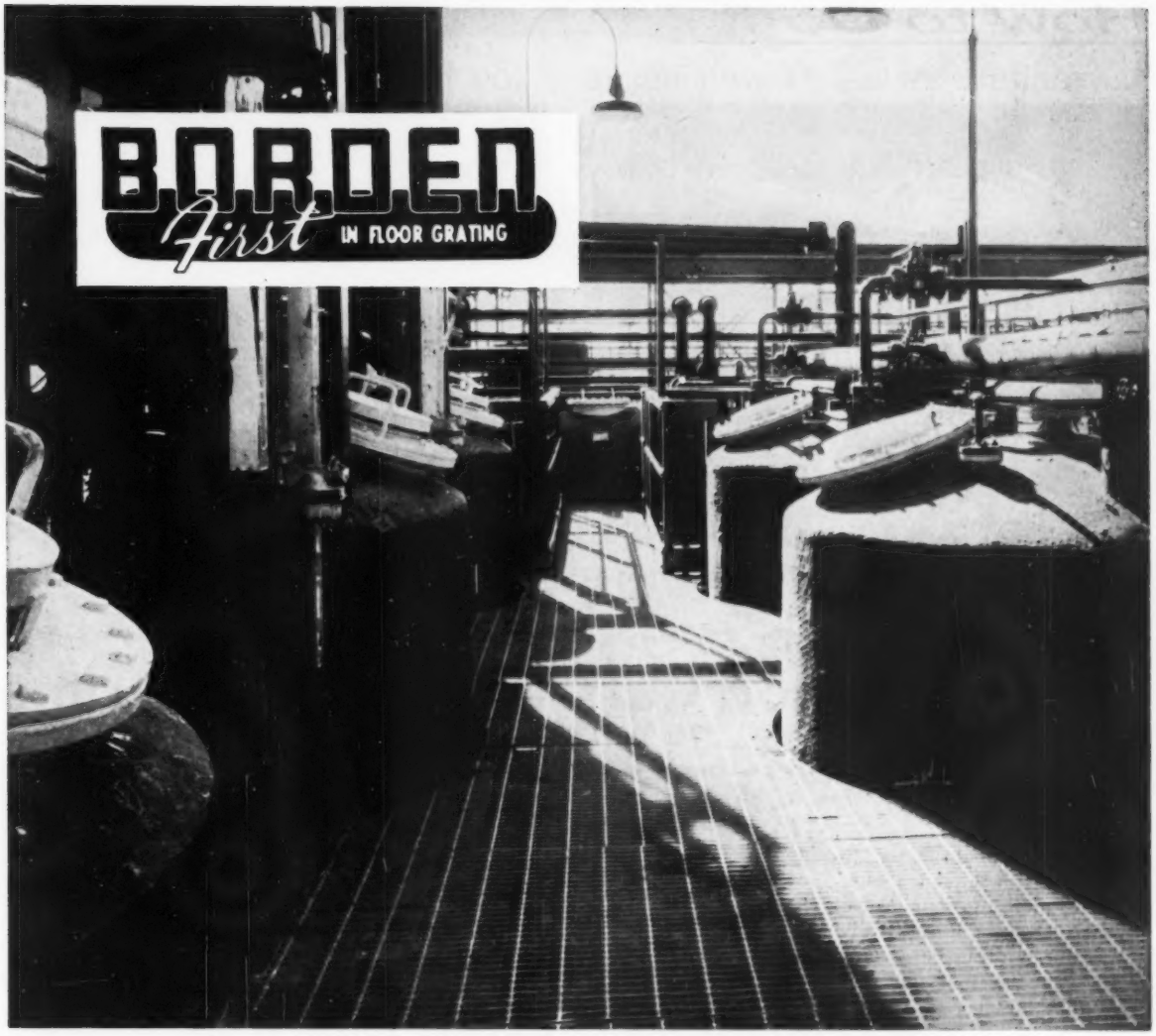
If you're interested in control system engineering, be sure to read the review of "A Simplified Technique of Control System Engineering," by G. K. Tucker and D. M. Wills. This new book is discussed along with several others in PETROLEUM REFINER's "New Books" department.

Keep Going to Page 294

Management Views Employe Turnover

If you're not acquainted with PETROLEUM REFINER's "As Management Sees It . . ." section, then you are missing out on some valuable information which is tailor-made for managers, supervisors, foremen, and those aspiring to such positions. One of the articles this month deals with a problem which consistently eats away at company profits—that is, employe turnover. This article, while emphasizing that employe turnover cannot be eliminated entirely, nevertheless contends that it can be reduced from an excessive rate. You'll get a good insight into how you can help control the turnover rate in your organization when you read "Cut Down Your Employe Turnover Rate."

Keep Going to Page 245



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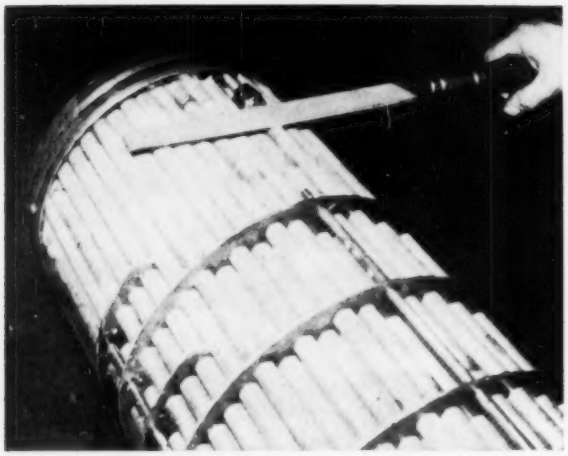
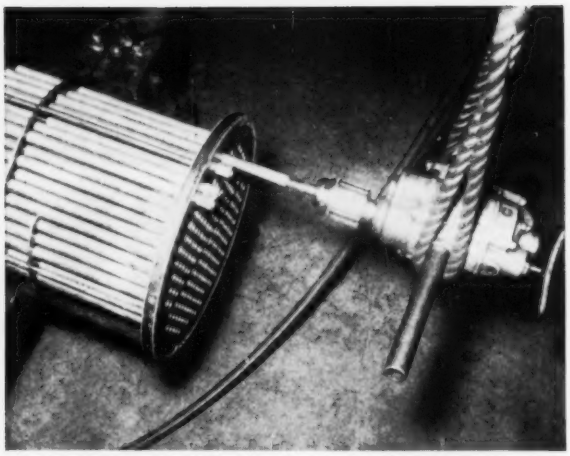




Stud bolt, three nuts and file (left) combine with plastic plug and tube roller (right) for easy tube removal.

Simple Method Cuts Tube Removal Time

Have a tube removal problem? Try this trick on removable exchanger tube bundles.

Loosen the tube in the floating tube sheet with a piloted tool; then drive the tube into and through the floating tube sheet until the tube projects about 8 inches beyond the stationary tube sheet at the other end of the tube bundle.

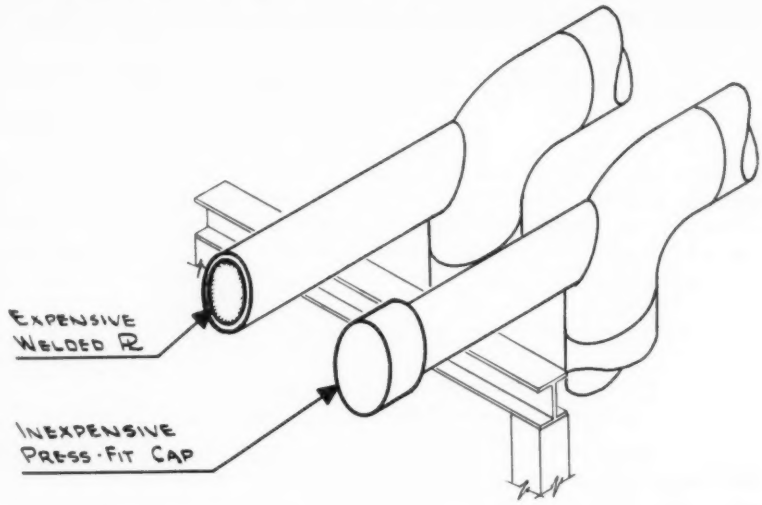
Get a 6 to 8-inch long stud bolt with diameter such that the ends will fit into a tube-sheet hole and the bore of the tube. Screw one nut on the stud bolt for about 1-inch distance. This nut will bear against the back side of the floating tube-sheet. Screw a pair of nuts on the other end of the stud bolt for a couple of inches and lock them together. This locked pair will bear against the end of the tube to be removed. Place the stud bolt with one end in the tube-sheet hole and the other end in the tube (left photo).

Place a tapered plug made of laminated plastic or other suitable material into the chuck of a drill or, as shown in right photo, the chuck of a tube-rolling gun. Insert the tapered portion of the plug into the projecting end of the tube.

While spinning the tube, file down the outside diameter of the tube for a distance equal to the thickness of the floating tube sheet. A few thousandths of metal removal will be sufficient to permit the tube to be withdrawn through the baffles and the stationary tube sheet (the left photo shows where and how the file is held).

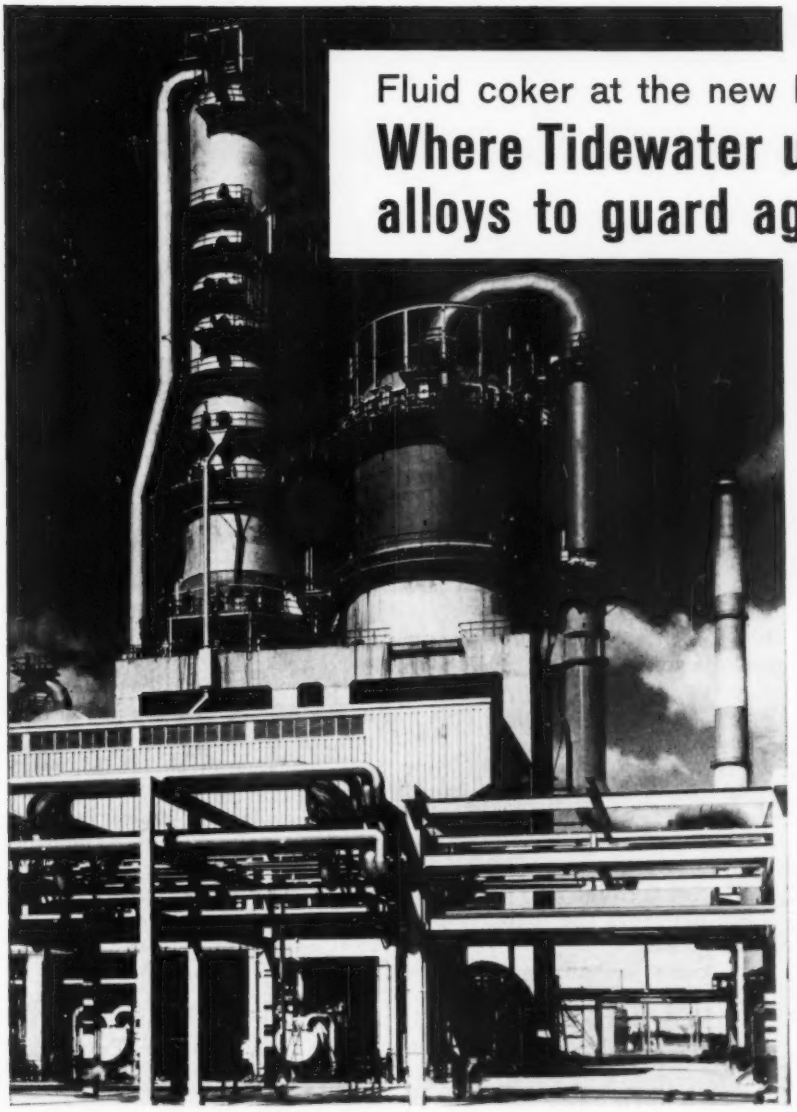
This method is particularly satisfactory when tubes are to be reused and/or where a small tube O.D. to baffle hole clearance exists. Tubes may be of the plain or low-fin variety.

This idea was submitted by Paul L. Bradley, Buffalo Walden Plant, Industrial Division, American-Standard.



Caps Seal Pipe Support Stubs Cheaply

In the design and construction of plant piping, many companies are closing the open end of pipe support stubs with steel plates welded to the open ends at costs of approximately $3.50 for a 2-inch stub to $9.80 for an



Fluid coker at the new Delaware Refinery...

Where Tidewater uses high nickel alloys to guard against corrosion

Here's the fluid coker at the Tidewater Oil Company's new Delaware Refinery, which boasts the world's largest initial capacity.

Like other units in this refinery, the fluid coker reflects latest practice in economical corrosion protection. To provide this protection, Tidewater engineers took full advantage of the properties of high nickel alloys. You'll find the details in the table below.

Throughout this ultra-modern refinery, high nickel alloys such as Monel* and Inconel* combat corrosion by mineral acids and other troublesome corrosives.

For more information, or for help with a corrosion engineering problem of your own, write Inco's Development and Research Division.

The INTERNATIONAL NICKEL COMPANY, Inc.
67 Wall St. New York 5, N. Y.

INCO
TRADE MARK

Schedule of Use of Monel nickel-copper alloy to combat corrosion by aqueous H_2S and HCl in fluid coker at the new Tidewater Refinery**

	EQUIPMENT	LOCATION	MATERIAL
Columns:	Fractionator	Top head	Monel-clad steel
		Shell, tray #17 to top	Monel-clad steel
		Trays #17, 18, 19	Monel alloy
Vessels:	Fractionator-accumulator	Nozzles	Monel alloy
	First commingler drum	"	" "
	Second commingler drum	"	" "
	Stabilizer accumulator	"	" "
	Blowdown quench drum	"	Monel alloy
	Main water seal vessel	"	" "
	Bypass water seal vessel	"	" "
Pumps:	Foul water pump	Casing, impeller	Monel alloy
Piping:	Foul water line, accumulator to stripper		Monel alloy

*Registered trademark **Where temperatures go above 500°-550°F, nickel-containing type 316 stainless and stainless-clad steel are also extensively used in this unit.

INCO NICKEL ALLOYS

For more data on advertised products, use Readers' Service Cards, last page.

Bench-type; 5½" scale.

New Speed and New Precision

WITH THE L&N STABILIZED pH INDICATOR

Quick Warm-Up—less than 60 seconds.

Fast Response—about 1.5 sec.

Measuring Errors "Designed Ou —completely unaffected by zero drift, electrical pickup, surges in a-c operating supply.

OnlyTwoAdjustments—standardization and temperature compensation (even compensation can be automatic if desired).

Fine Performance—limit of error ±0.1 pH; reproducibility ±0.02 pH.

Low Price—$295.00 for 120 v. model; $345.00 for 240 v. model, f.o.b. Phila. (subject to change without notice). Electrodes, buffer, KCl solution included.

Use No. 7664-A1 (120 v.) or 7666-A1 (240 v.) when ordering. Leeds & Northrup Co., 4923 Stenton Ave., Phila. 44, Pa.

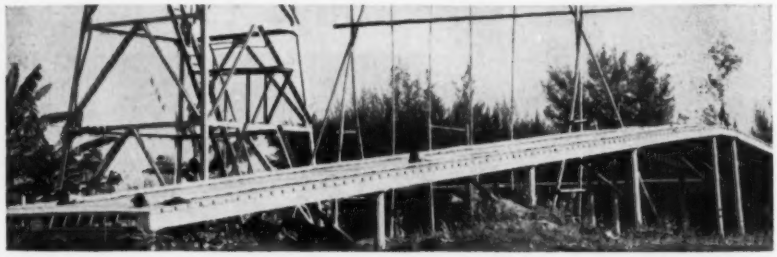
LEEDS NORTHRUP
Instruments Automatic Controls • Furnaces

How To Do It

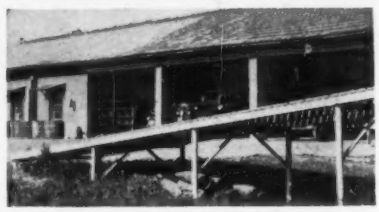
8 inch stub. There is, of course, a higher cost for larger pipe stubs.

Plastic or metal press-fit caps placed over the open end of pipe support stubs will accomplish the same purpose at a fraction of the high cost of welded plates. This enables a savings of hundreds or thousands of dollars per plant.

This idea was submitted by B. L. Riggs, Bartlesville, Okla.



Hose Drying Rack Made From Scrap Pipe, Lumber



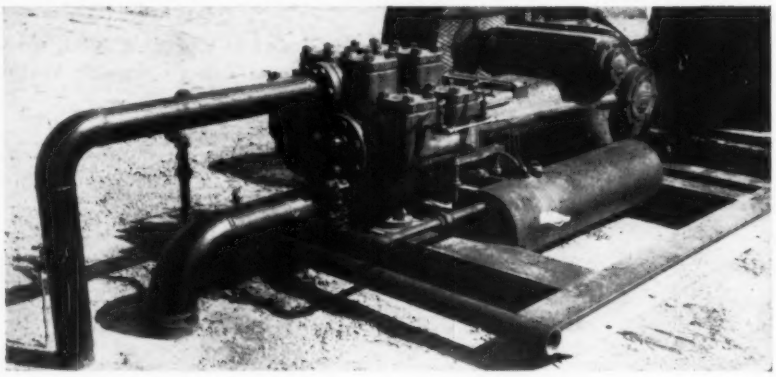
A fire hose will have a long and serviceable life, if given proper care. It is important to keep it clean and dry after use. Mildew, mold and other forms of rotting usually result from improper hose drying.

The Chinese Petroleum Corp's. Formosa refinery built a hose drying rack from scrap pipe and retired tank rafters. It is built in the form of a bridge, five feet wide by six feet high and 52 feet long. The hose is supported through its full length which prevents the formation of water pockets.

Features and advantages of a bridge type rack are:

- The sloping bridge makes loading simple and allows water to drain quickly.
- Half-inch spacing between boards permits excess water to drop through the structure and induces the circulation of air for faster drying.
- Hose damage caused by tears, snags and abrasions from dragging the hose over rough concrete is reduced to a minimum because the hose is refolded on the rack.
- Mashed threads and damaged coupling swivels are also reduced by handling the hose on a wooden rack.

This idea was submitted by Tzen Yung Yang, Chinese Petroleum Corp., Kaohsiung, Taiwan (Formosa).



Sump Tank Mounts on Pumping Unit Base

In refineries where skid mounted pumps are used, the location and installation of the sump tank will increase the portability if it is contained within the unit.

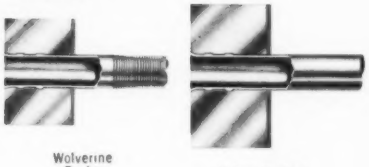
One company uses a tank built into the skid base so that all connections are moved with the pump

WOLVERINE
TUBE

Items of Interest to the Processing Industry

PUBLISHED BY WOLVERINE TUBE DIVISION

Trufin Type S/T is Interchangeable with Prime Surface Tube



Wolverine Trufin Type S/T Condenser Tubing

Prime Surface Condenser Tubing

Because it is designed specifically for use with shell and tube condensers, the dimensions of Wolverine Trufin Type S/T are such that it is completely interchangeable with prime surface tubing.

For example, the outside diameter of the finned section of the tube is no greater than that of the plain end, which permits Type S/T to be threaded and rolled into headers as easily as bare tube—using exactly the same techniques and retubing tools.

As an additional design feature, the wall of the plain end section is approximately two gauges heavier than the specified tube gauge. This provides a better bond at the tube sheet and offers additional protection against inlet erosion.

FIELD ENGINEERING SERVICE OFFERS SKILLED HELP

For the convenience of its customers Wolverine Tube maintains its Field Engineering Service — a staff of highly trained tubing technicians.

In addition to their own specialized backgrounds these men are backed by the experience and knowledge gained by Wolverine Tube during its years as a leading supplier of tubing for heat transfer applications.

Members of the Field Engineering Service group are available at all times to help solve problems in design, corrosion, tubing selection—or what have you. Next time you have a problem ask for a Wolverine Field Service Engineer — there is no obligation.

THE CASE OF THE UNUSED PRODUCTS COOLER

BY ERNEST DODD

Here's a true story which we think you'll find interesting. It concerns a problem engineers at a large Gulf Coast Refinery (near Houston), ran into with a product cooler that had insufficient surface to handle the required heat load.

Actually it isn't a very difficult problem. It happens frequently and until recently there was a standard solution: just design a bigger unit capable of handling the desired heat load. Of course it's expensive and it takes time —but it does provide a solution to insufficient heat transfer surface.

Well that's what happened here. The engineers took a look, figured out what was needed and a new exchanger was approved and ordered. Which should have been the end of the whole thing.

But you know how it is sometimes. While the refinery was waiting for the new unit to be built and shipped—the old one started to act up. The engineers looked it over and decided to retube—with Wolverine Trufin® Type S/T—the original, integrally-finned condenser tube.

Now here's the part of the story we like. All this happened two years ago. During this time the original cooler—which was retubed with Trufin Type S/T, has been continuously on stream and has easily been handling the desired increase in heat load. And the new unit? Well it has never been required.

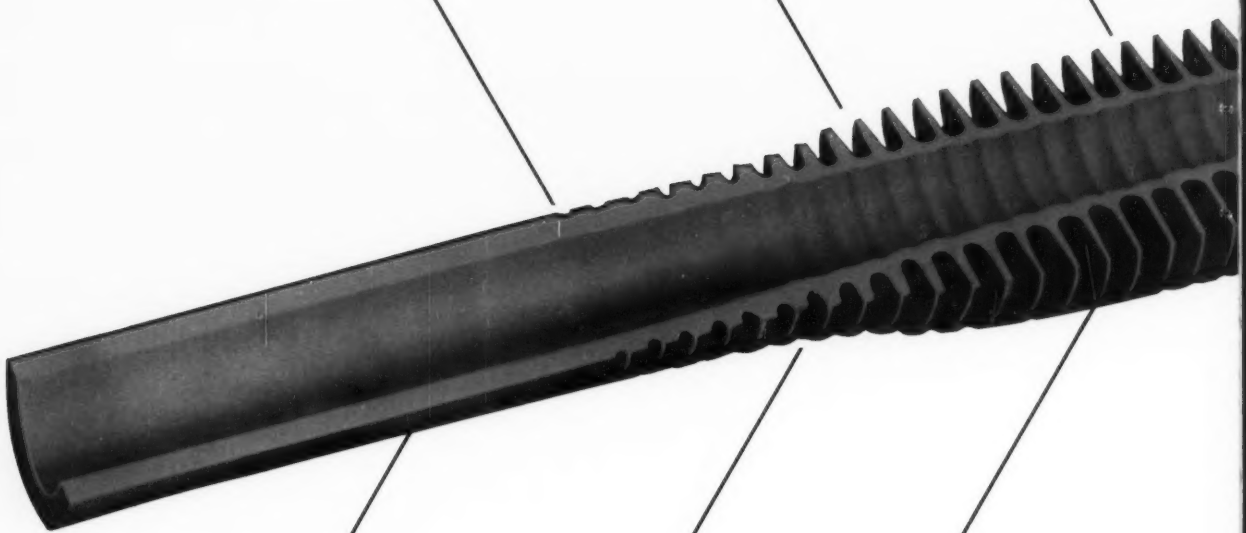
This is but another example of the countless installations where Wolverine Trufin Type S/T is helping the processing and refining industries do a better heat transfer job — at less cost.

If your company is contemplating the design of new equipment or retubing old, why not get more information about Wolverine Trufin Type S/T before going any farther. You'll be amazed and delighted at the way this integrally finned tube can increase capacity and reduce operating expense.

interchangeable with plain condenser tube (Type S/T only)

easily fabricated—available in U-bends

one-piece construction



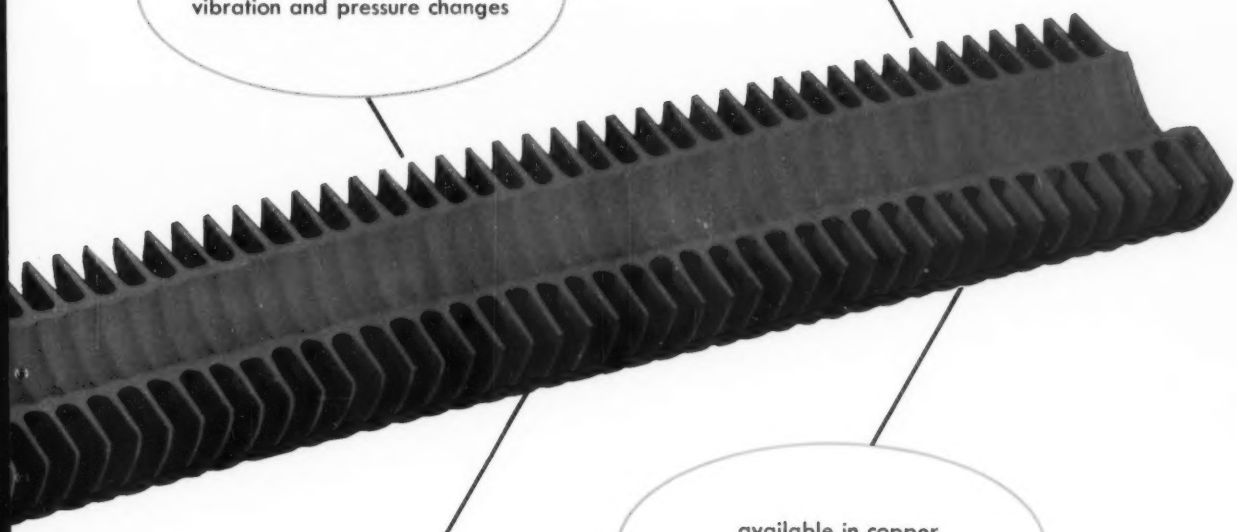
several types of end treatments available

high finned outside to inside surface ratios up to 8-1. (Types H/R, L/C, and I/L)

available with either high or low fins with a wide variety of fin spacings

smooth extruded fins eliminate sharp angles and crevices

fins stand up under thermal shock, vibration and pressure changes



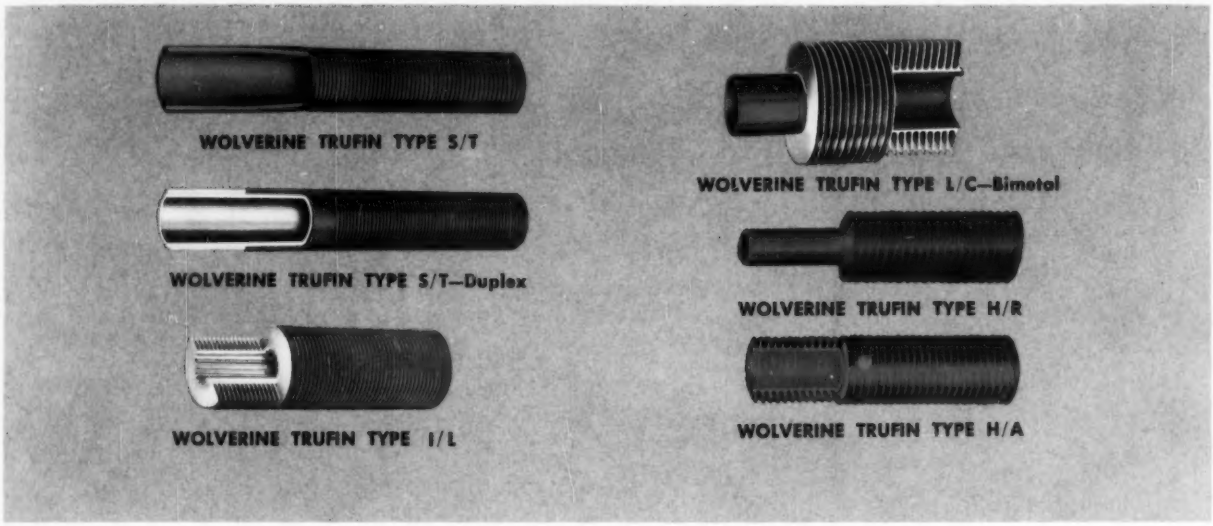
available in copper, copper alloys and aluminum

more BTU's per foot of tube

THIS IS WOLVERINE TRUFIN!

Look at the advantages—see for yourself what Trufin can do for you. Specify it for new installations and for retubing at turn-around time. You'll do a bigger job . . . boost production . . . save money, too!

WOLVERINE TUBE PIONEERED DEVELOPMENT OF INTEGRALLY-FINNED CONDENSER TUBE


WOLVERINE TRUFIN TYPE S/T
WOLVERINE TRUFIN TYPE S/T—Duplex
WOLVERINE TRUFIN TYPE I/L
WOLVERINE TRUFIN TYPE L/C—Bimetal
WOLVERINE TRUFIN TYPE H/R
WOLVERINE TRUFIN TYPE H/A

Since its inception in 1916, Wolverine Tube has devoted a great deal of its research and engineering facilities to problems encountered in the field of heat transfer.

Perhaps the most significant of the advances coming from this specialization was the development of Wolverine Trufin® —the original, integrally-finned condenser tube.

In bringing Trufin to its present superiority, Wolverine Tube has engaged in many activities widely separated from actual tube manufacturing.

For many years, for example, Wolverine has worked hand-in-hand with research groups at the University of Michigan. As a result of the tests and studies made during these research activities, theories have turned into facts and the formerly unknown field of finned tubing has become a known way. D. Q. Kern Associates have helped to pioneer additional design and application procedures using Wolverine Trufin. They have served as heat transfer consultants and their contributions have resulted in innumerable customer benefits and advances in the field of heat transfer.

In sharing its fund of finned-tube knowledge, Wolverine has worked closely with the fabricators of heat transfer equipment. For the benefit of its customers and industry in general, Wolverine also conducts a series of Technical Seminars dealing with integrally-finned tube and its applications.

Wolverine Tube is proud of its contributions to both heat transfer and finned tube knowledge. Next time your company requires extended surface tubing investigate Wolverine Trufin before you order. Remember, it is the original, integrally-finned condenser tube. Write, too, for a copy of the Wolverine Trufin catalog.

Speaking of heat transfer knowledge, we'd like you to meet Harry F. Powell, one of Wolverine Tube's two Technical Sales Representatives located in the Southwest. In addition to his own extensive engineering background, "Fil" Powell has undergone much specialized training at Wolverine plants and is a graduate of the Wolverine Heat Transfer Course. He recently was elected V-P of the Heat Transfer Engineers Society in Texas. If you're located in the Southwest, you can get in touch with "Fil" at 2 North York St., Houston 3, Texas. Give him a call next time you need tubing or have a tubing problem.

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Manufacturers of Quality Controlled Tubing and Extruded Aluminum Shapes

Wolverine Trufin is available in Canada through the Unifin Tube Division, London, Ontario.

PLANTS IN DETROIT, MICHIGAN AND DECATUR, ALABAMA. SALES OFFICES IN PRINCIPAL CITIES.

and the vessel remains intact. This allows the pump to be moved by simply disconnecting the suction and discharge lines, and the fuel lines.

The tank is made of eight-inch pipe and sets down between two members of the skid base, as shown. It is beside the pump and is convenient for connecting the bleeder lines from the valve chambers on either side of the pump with copper tubing. The tank is lower than the pistonrod chamber and the gravity lines are run across with ¾-inch pipe.

Near the top of the front, a ¾-inch connection is made and a nipple run to the bottom of the tank. This line is connected to the suction of the pump, in front through a gate valve. When the sump becomes nearly full, the valve is opened, sucking out the contents.

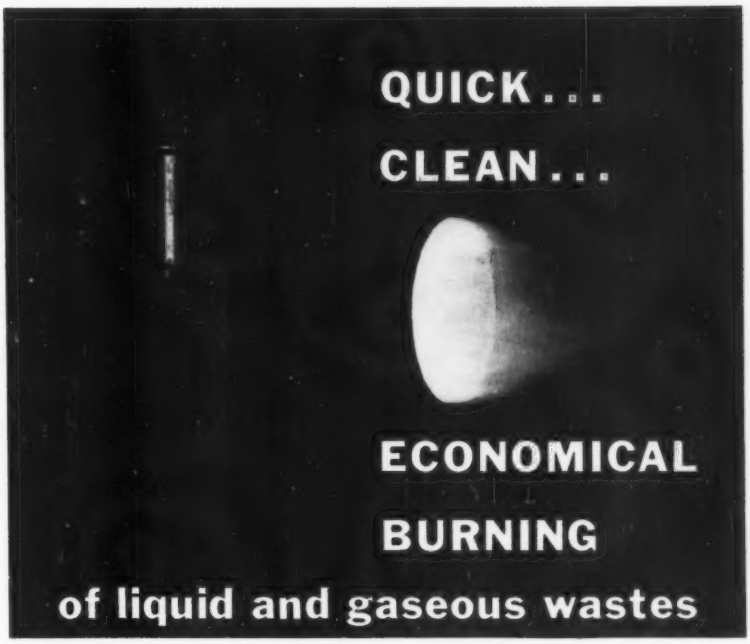
Small Sample Cuts Asphalt Penetration Test Time

The time taken to carry out the ASTM penetration test for asphalts can be cut down considerably from the two hours required without loss of accuracy by using a smaller sample of asphalt.

Simply use 1 inch O.D. piping (preferably aluminum for lightness) about 1 to 1½ inches long for asphalts in the 0-150 pen range, and slightly wider and longer sections for the softer asphalts.

The pipe sections can be placed on an amalgamated brass sheet. Unless the asphalt is very hot it will not run out the bottom. For asphalts up to 150 pen, 20 minutes cooling in air and 20 minutes in the bath (and for the softer asphalts 30 minutes in air and 30 in the bath) are just right. Provided the pipe section is filled to the top and there are no air bubbles, accuracy compared with the standard test is 100 percent for asphalts up to 150 pen. After that it is a little on the hard side, but extreme accuracy is not required on the softer asphalts. When the sample is cooled in the air, cut off the surplus asphalt from the top of the pipe section. When the penetration is taken, if the pipe section is turned upside down, this will present a good smooth surface for the test.

This idea was submitted by: E. D. Cooke, Excelsior Refineries, Ltd., Lloydminster, Alberta, Canada.



IN THE THERMAL VORTEX BURNER!

Short, clean flame and compact size make the THERMAL Vortex Burner the perfect solution to many industrial waste disposal problems. Combustible liquid and gaseous wastes can be fed directly into the burner, eliminating the need for expensive, space-consuming incinerators. Combustion takes place quickly with an absolute minimum of smoke and odor. Where necessary, a conventional fuel may be fired to supplement the firing of the waste material. Simply and compactly designed, the THERMAL Vortex Burner can also become the nucleus of an efficient heat recovery system.

THERMAL'S laboratory facilities are available for trial burning of wastes. In addition, our staff of engineers is equipped to do complete turn-key designs to solve your waste burning problems. For further information, write for Bulletin #116.

Some of the waste materials that the THERMAL Vortex Burner has burned include:

1. Paint and lacquer residue.
2. Nitrogen rich petroleum residue.
3. Ethylene dichloride.
4. Aromatic water mixture.
5. Phenol tar.
6. H_2S
7. Nitrated and chlorinated aromatics.

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a tradition with engineers since 1912

Flexitallic Spiral-Wound Gaskets are bought for what they do . . . and keep on doing . . . in pipe lines and pressure vessels across almost all industry.

Flexitallic Gaskets are the safe seal, preferred by engineers since the development of the original Flexitallic Spiral-Wound construction in 1912.

In confining fluids at high pressures, and high temperatures, engineers know and depend on Flexitallic Gaskets because:

- The compression characteristics for a given series are always related to the bolting load for that series.
- With the gasket design determined, exacting mechanical controls assure that manufactured gaskets conform to specification.

To get this unvarying standard of quality in Spiral-Wound Gaskets, look for the blue dye in the Canadian asbestos filler — Flexitallic Blue, the mark of an engineered Flexitallic Gasket.

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8th & Bailey Sts. Camden 2, N.J.

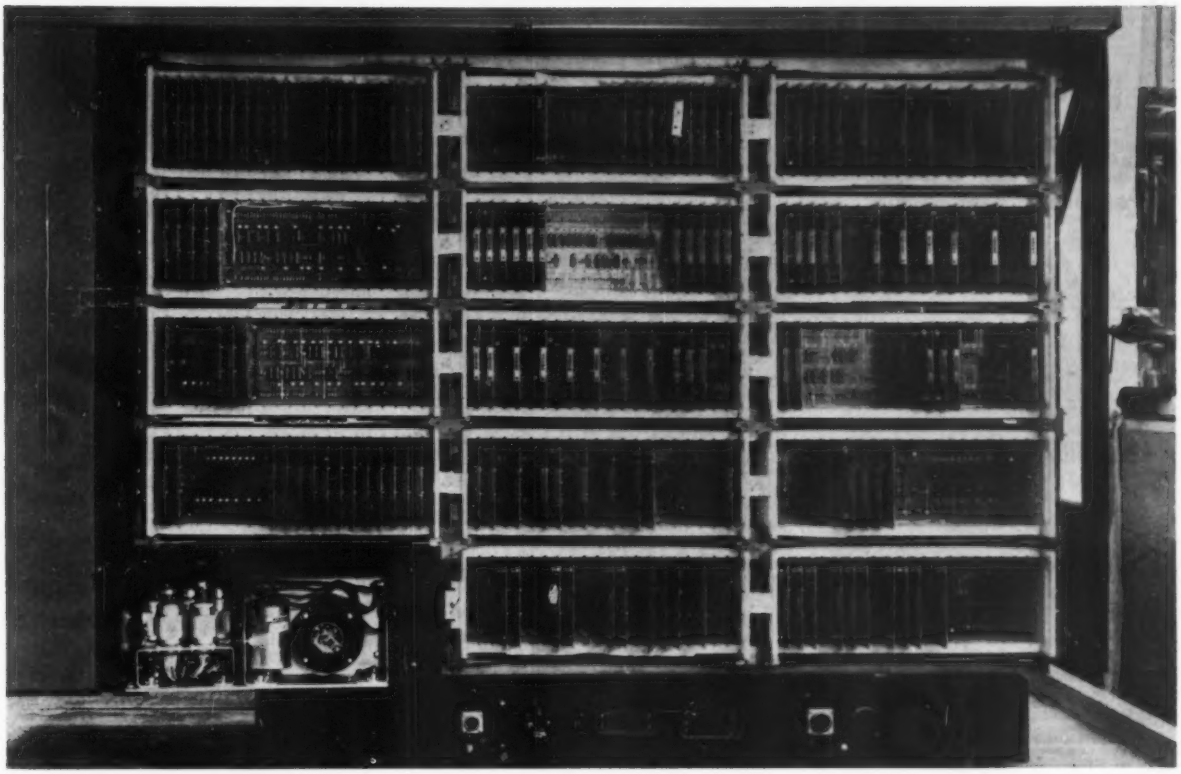
Flexitallic®
SPIRAL-WOUND GASKETS

FOR PIPE FLANGES, PRESSURE VESSELS AND PROCESS EQUIPMENT

*Flexitallic is a registered tradename. No one else can make a Flexitallic Gasket. Look for *Flexitallic Blue* — it's our exclusive blue-dyed Canadian asbestos filler.

For more data on advertised products, use Readers' Service Cards, last page.

Who's Building...



Some features shown here are in the system guiding B. F. Goodrich Chemical Co.'s Calvert City, Ky., plant.

Computer Now Directs Plant Operation

Goodrich's plant for vinyl chloride monomer uses a digital computer in its control loop

B. F. Goodrich Chemical Co. is installing a fully-automated vinyl chloride monomer production unit at its Calvert City, Ky., plant. To be completed this June, it is reportedly the first in the chemical processing field to utilize this revolutionary digital system to operate a chemical process specifically designed for computer control.

The system, engineered by The Thompson-Ramo-Wooldridge Products Co., Los Angeles, will exercise "closed loop" control over the process and will log operating data and computed values. The computer accepts instrument signals, computes at great speed, makes logical decisions, and transmits signals to adjust the set points of numerous controllers in the process.

By providing a degree of process control not otherwise attainable, the new computer will maximize the efficiency of the production unit. The many variables of plant operation are continuously monitored, automatically analyzed, and the entire system adjusted to reach optimum efficiency, according to the company.

Investment for the computer, with its auxiliary equipment, and including installation, programming, and training of personnel will be nearly $200,000.

No larger than an office desk, the Goodrich control unit weighs approximately 600 pounds. The company reports it is the first industrial computer to incorporate many features of digital computers developed to control missiles and advanced aircraft. These features include built-in analog-digital conversion equipment, reliable transistorized circuitry, printed wiring, modular construction, and a

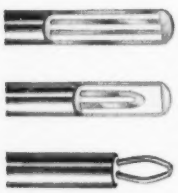
SERV-RITE®

Premium Sheathed Thermocouples
(.020" to .500" O.D.)

Problems of space limitation, temperature, or pressure are solved with SERV-RITE *premium* sheathed thermocouple wire. For maximum sensitivity, accuracy and quick response, SERV-RITE will furnish the best service for your dollar.

Featuring hard-pack insulation with heavy wall construction, SERV-RITE is fully flexible and can be bent to suit requirements. In addition to a choice of junction tips, fittings and connectors, SERV-RITE *premium* sheathed wire is available in a wide range of sheath materials, bright annealed. Standard and special thermocouples are made to suit any need.

All wires used in SERV-RITE *premium* sheathed thermocouple wire are selected and matched to conform to "Special" limits of error as set forth by I.S.A. Recommended Practice, R.P. 1.3. This wire meets the strictest over-all specifications.



Ask for BULLETIN 1200-4

for complete details, ordering data, and prices on SERV-RITE *premium* sheathed thermocouple wires and accessories.

SERV-RITE *premium* sheathed thermocouple wire is manufactured exclusively by Pyro Electric Company.

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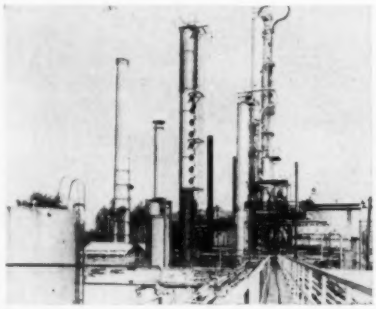
Building

large magnetic drum memory. The computer can store 8,000 numbers or computer words in its memory, and can add 1,100 numbers per second and multiply 350 per second.



An 80-foot distillation tower has just gone on stream at the Franklin, Pa., refinery of L. Sonneborn Sons, Inc. The 30-ton unit was erected by outside contractors, with pipe-fitting, installation, and steel work handled by the refinery's own construction crew.

Texas Natural Gasoline Corp. and Tennessee Gas Transmission Co. have completed a 150-MMcf-per-day gas processing plant 15 miles southeast of New Orleans. The plant, to be operated by Texas Natural, will process gas from fields in Southern Louisiana and the Mississippi River Delta area. Natural gas liquids will be recovered by a combination absorption-refrigeration process operating at —20F. Product fractionation facilities will handle 380,000 gallons per day of liquid product, including propane, normal butane, isobutane, and natural gasoline. Additional products will be produced when more gas is available.

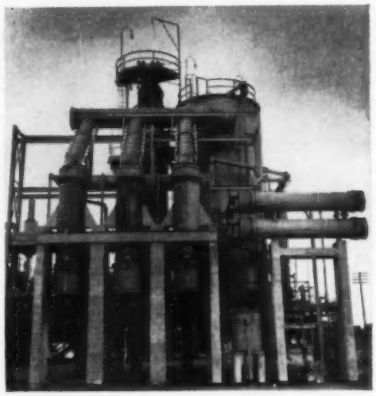
The Fluor Corp.'s Mid-Continent division handled design, engineering and construction.

La Societe Normande de Matieres Plastiques and Pechiney, two French industrial groups, have signed license agreements with Montecatini Co. for use of the Montecatini-Ziegler patents for production of polypropylene. Two plants, each with an annual capacity of 22 million pounds, will be built in France to produce the new plastic. Exact location of the plants has not been disclosed. Construction will begin immediately with both plants scheduled to go on stream in 1960.

Standard Oil Co. of Calif. has installed what is reportedly the world's first UOP Butamer unit, at its Richmond refinery. It will produce about 2,000 bpd of net isobutane by isomerization of normal butane. The Butamer unit will use a fixed-bed catalyst having high activity. The isomerization reaction is carried out in a hydrogen atmosphere, employing moderate temperature and pressure. Estimated completion date is June, 1959.

BP Trading Ltd.'s Kent refinery has a new thermal reformer designed by Kellogg International Corp., London. The 12,000-bpsd unit is designed for single-pass thermal reforming of either light or heavy naphtha fractions from Middle East crudes to produce a debutanized reformate of maximum research octane rating. It can also handle Platformates of similar boiling ranges. Continuous operation of the unit for 2,000 hours was a design requirement. To make this possible, two 6,000 bpsd reforming furnaces were provided. Either can be taken out of service for decoking and restarted without interrupting the unit's operation. The feed rate to the unit has to be reduced when decoking one furnace.

The main tower separates the reforming furnaces' effluent into a heavy bottoms liquid and an overhead vapor product. The former is stripped of its lighter components to produce a fuel oil. The overhead vapor product, containing the reformate, is clay treated to remove undesirable polymers formed in the reforming reaction and then passed on for final fractionation in an afterfractionator, a debutanizer and, finally, a depropanizer.



Three huge impervious graphite shell and tube heat exchangers have gone into service at the Beaumont plant of Olin Mathieson Chemical Corp. Operated vertically and in parallel flow with each other, they are used in the recovery of sulfuric acid from acid sludge. Approximately 500 gallons of treated cooling water a minute is required to handle a heat load of several million Btu's an hour.

Standard-Vacuum Oil Co. reports that American and Australian capital will finance a new petrochemicals industry in Australia. The $50-million project involves four plants, to be located near Melbourne. End-products will include polyethylene, polystyrene and GRS-synthetic rubber. Construction will start soon and the plants will reportedly be in production by mid-1961.

Vacuum Oil Company Pty., Ltd., will build and operate the key unit of the four-plant setup, producing ethylene and butadiene from selected petroleum hydrocarbons processed at Stanvac's Altona refinery near Melbourne.

Union Carbide Corp.'s Australian af-

US RUBBER MATCHLESS #5 STEAM HOSE

3 Men . . . 3 Applications
One Hose

Safety
U. S. Matchless #5 Steam Hose has been used at a Phillips Petroleum refinery* since 1930, for thawing and firefighting.

Easy Handling
Here U. S. Matchless #5 is being used to remove spilled oil.

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Warehouse boss at Phillips Petroleum inspecting a length of U. S. Rubber Matchless #5 Steam Hose.

Men like to work with U. S. Matchless® #5 because it's so lightweight, so flexible. Ordinary hose is hard to handle, can't take much dragging around. But the hose that's readily available, lasts longer, and satisfies the operators is the best investment. That's U. S. Matchless.

When you think of rubber, think of your "U. S." Distributor. He's the best on-the-spot source of technical aid, quick delivery, and industrial rubber products.

*Okmulgee, Okla.

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PREPARES RUSTED METAL FOR PAINTING...

Send for FREE Test Sample

Eliminate sand-blasting or flame-cleaning. Simply brush off loose rust and apply OSPHO on the rusted metal surface. One application *kills* the rust and provides a *sound* base for your regular maintenance paint. Rust action is stopped — paint jobs last much longer.

OSPHO is *not* a primer — *not* a paint. It is a carefully balanced phosphate chromate metal treatment which chemically changes rust (iron oxide) into iron phosphate — an inert, hard, gray surface ideal for painting.

OSPHO provides excellent coverage . . . a gallon treats up to 600 square feet. And cost is low. Available in 1-gallon containers (in cases of 4), 5-gallon pails, 50-gallon barrels. Colorless, non-toxic, non-flammable. Available through distributors.

Repeat orders over the past 16 years are proof of OSPHO's effectiveness. *See for yourself . . .*

Write Now For FREE Test Sample
(on company letterhead)
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TREATS NEW METAL TOO!

When applied on new ferrous metal, galvanized iron and aluminum, OSPHO imparts a slight etch to the metal, insuring tight bond of the paint coat that follows.

ONLY OSPHO KILLS THE RUST

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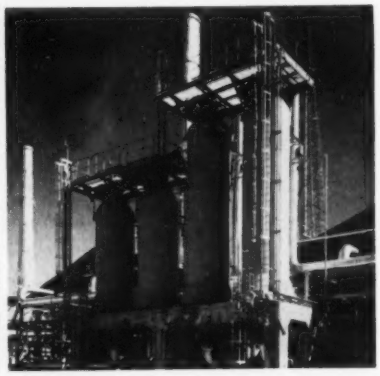
QUALITY MAINTENANCE PRODUCTS SINCE 1917

Building

filiate will build a polyethlene plant. Another chemicals company, still to be formed, will build a styrene plant. Both will be adjacent to Vacuum's petrochemicals unit which will supply them with ethylene.

Styrene and butadiene will be used to make GRS-synthetic rubber in a fourth plant of the petrochemicals group. Companies manufacturing tires in Australia will be invited to participate in this unit.



A multimillion dollar octane improvement project was recently completed at Shell Oil Co.'s Norco, La., refinery. Several major operating units were installed, the main one being a 16,000-bpd Platformer capable of high severity operation.

Reichhold Chemicals, Inc., has begun construction on a new $5-million chemical plant. Badger Manufacturing Co. is handling engineering and construction. Scheduled for completion late in 1959, the plant will produce some 30 million pounds annually of phthalic anhydride, an important chemical used. Production will be by the fluid bed catalyst technique, assuring the highest quality. The plant's 30 million pound yearly capacity will make it one of the largest in the world to use this method and the design leaves plenty of room for future expansion.

The Standard Oil Co. (Ohio) has begun construction of a $650,000 addition to the lube plant and a revamp of wax facilities at the Lima, Ohio, refinery. The program includes completed installation of continuous molding equipment, costing some $365,000, in the Sohio No. 2 refinery, Cleveland. Completion is scheduled for May 1. Formerly, wax production was 12,000 pounds per eight-hour shift. Installation of the new machinery makes it possible to mold 60,000 pounds in one shift.

Western Natural Gas Co. has acquired a refinery near Brownsville, Texas, formerly operated by McBride Oil and Gas Corp. It is being revamped to process approximately 3,500 bpd, making asphalt and related products, kerosene, and diesel fuel. Capacity can be increased to 5,000 bpd. The company plans to use

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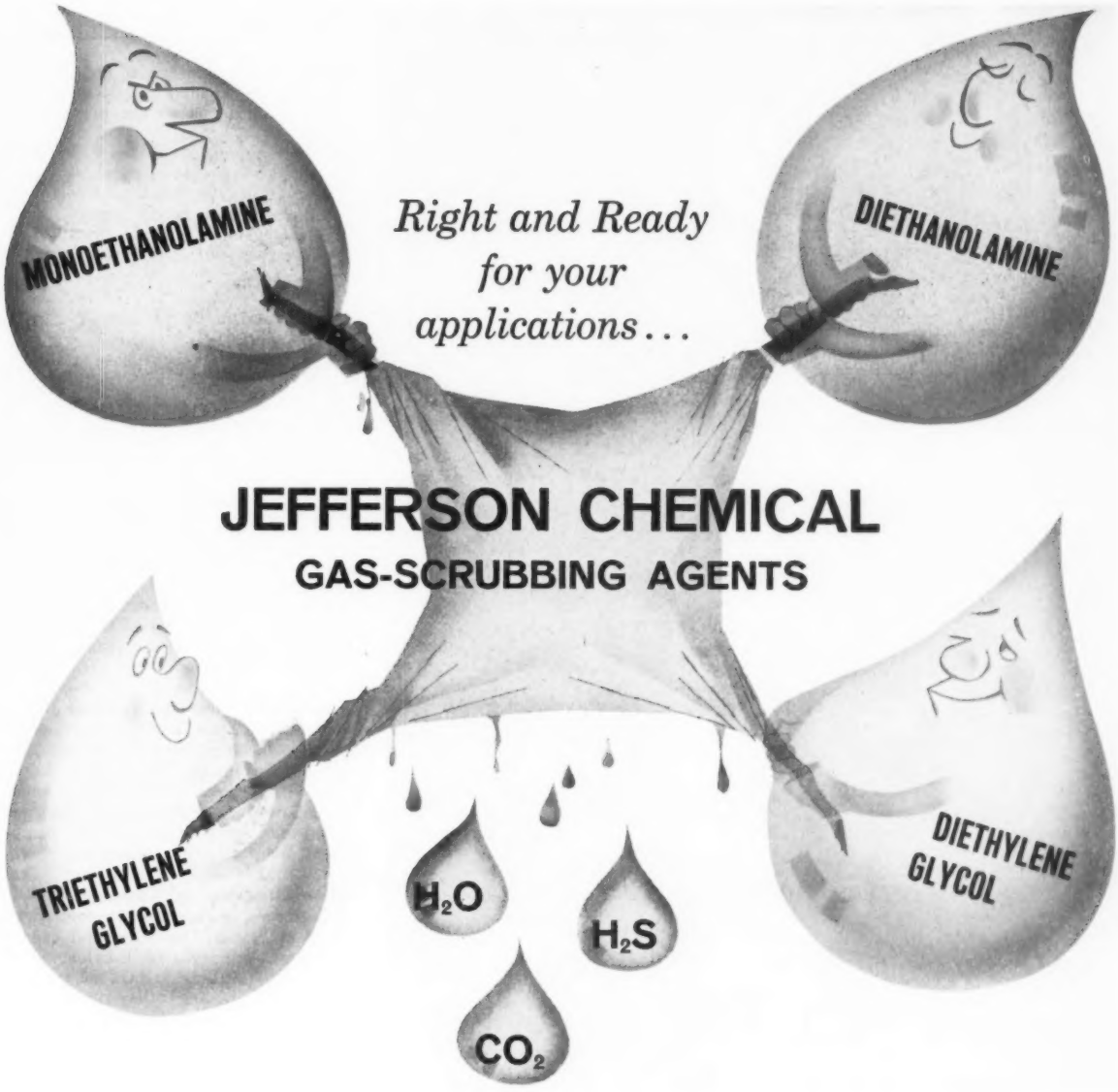

Whatever your applications in natural gas sweetening, refinery stream sweetening, sulfur recovery, gas dehydration, and carbon dioxide absorption . . . Jefferson Chemical has the right products in the special grades and quantity you desire.

You may utilize the most convenient size shipment and carrier for your production and storage needs . . . single-product or compartmented tank cars of 4,000- to 10,000-gallon capacity, single-product or compartmented tank wagons of 1,000 to 4,000 gallons, or 55-gallon drums.

Combine these high purity chemicals and prompt, accurate shipments with Jefferson's experience and complete willingness to render every possible technical assistance, and you have a first-rate source for your "Gas-Scrubbing" needs. Ask your Jefferson man at 1121 Walker Avenue, Houston 2, Texas.

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Ethylene Oxide, Glycols, Dichloride • Ethanolamines • Morpholine • Piperazine
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Essential Chemicals From Hydrocarbon Sources

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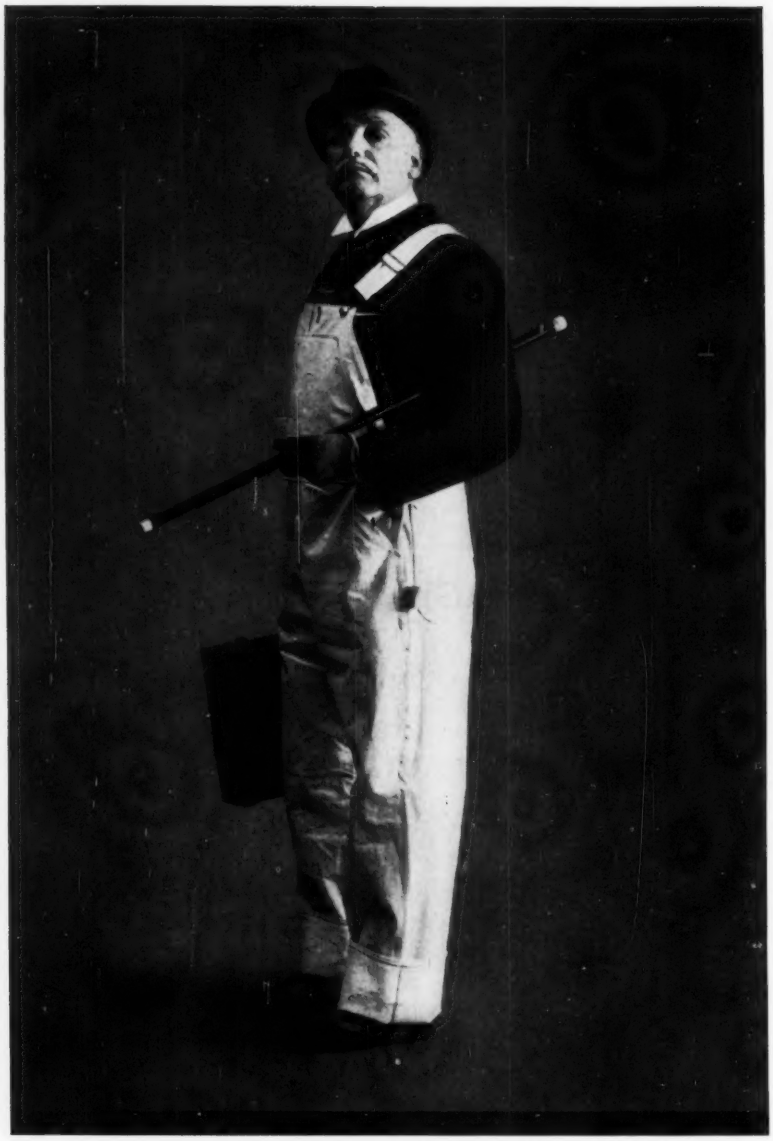

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You can put overalls on a man, but can you expect a man's thoughts to "wear working clothes?"

We think so. That's why—once you tell us your requirements for a process such as reforming—you can expect us to show up ready to *work*.

You can also expect new ideas. And with them comes wide experience in catalysts, catalyst research, pilot plants and all grades of charge stocks. This is your assurance of results—top efficiency from the Houdriforming or Iso-Plus Houdriforming process best for producing high octane gasoline or aromatics from your raw materials.

Our "shirtsleeve-kind of service" continues—to help you maintain peak efficiency—*after* the process goes on stream. Mentally and physically, we *stay* dressed for work as long as we're serving you.

*HOUDRY

PROCESS CORPORATION
1528 Walnut Street, Philadelphia 2, Penna.
*Houdry means Progress...through Catalysis

Building

heavy Venezuelan crude, and the lighter distillate and other products extracted from natural gas, as the principal feed stock.

The company also plans to build three small gasoline extraction plants—one in the San Salvador field in Hidalgo County, another in the Nursery field in Victoria County and the third near the St. Charles field in Aransas County, all in Texas.

Fertilizantes Sinteticos of Peru has almost completed construction of a $10-million petrochemical plant. Scheduled to begin operation this year, the plant's output will include 30,000 tons of ammonium nitrate, 1,500 tons of nitric acid, 1,000 tons of anhydrous ammonia and 15,000 tons of ammonium sulfate.

Iran is planning a nitrogen fertilizer plant, the country's first. A 100-metric-ton-per-day ammonia plant will be the key unit. The $30-million project will be handled by ENSA, a French-British partnership which will work with Montecatinni Co., general advisor to the Iranian government on the plant, and supplier of the process.

Firestone Tire & Rubber Co. is planning a plant for polyisoprene and polybutadiene rubbers. To be built at the company's Orange, Texas plant, the new unit will produce 30,000 tons per year of either product. Preliminary engineering has been completed and the plant is slated for production within two years.

Dow Chemical of Canada, Ltd. has completed a low-pressure polyethylene plant at Sarnia, Ont. Cost and capacity have not been revealed. Ethylene for the plant is furnished by Dow's nearby ethylene plant, and other raw materials may be obtained from Imperial Oil, Ltd.'s Sarnia plant. Engineering and construction were handled by Catalytic Construction Co.

British American Oil Co. will soon begin a program to increase capacity of the catalytic cracking unit at its Clarkson refinery near Toronto, and add more processing facilities at the refinery's lube oil and grease plant. A continuous blender, new tankage, canning and packaging facilities are included.

Shell Chemical Corp. (Australia) is planning a $2.2-million resin plant at its Clyde refinery. The company has completed a sulfuric acid unit at its Geelong plant, and plans to add a detergent alkylate unit there.

Sunray Mid-Continent Oil Co. has started construction on a new $600,000 automatic gas-products plant in Jackson County, Texas. The refrigeration oil-absorption type plant is scheduled for completion this month. It will process approximately 30-MMcf of gas a day and produce 27,000 gallons a day of propane,

For more data on advertised products, use Readers' Service Cards, last page.

isobutane, normal butane and natural gasoline. It is designed to recover approximately 80 percent of the propane, butane and heavier hydrocarbons. The unit will be among the first plants of its type to operate unattended at night. Four men will man the plant during daylight. Gas to be processed at the plant will come from the nearby Appling and Olivia fields.

Imagination can fit beauty and symmetry into functional requirements of industrial design as Blaw-Knox Co. did on this refinery control center for the La Gloria Oil and Gas Co.'s Tyler, Texas, Refinery. The center is a circular, air-conditioned building with double glass insulating walls enclosing a room approximately 50 feet in diameter. The three control panels, facing outward on the sides of an equilateral triangle, are connected at their ends by wall panels to form a central hexagonal service room. Each operator, seated in front of his control panel, also has a panoramic view of the refining unit under his control.

Sunray Mid-Continent Oil Co. is building a natural gasoline plant and gathering system in McClain County, Okla. The 5-MMcf plant will be the refrigerated oil-absorption type, and will cost $1 million. Completion is slated for July.

Standard Oil Co. (N. J.) will team with Beryl Algerie Compagnie Francaise des Petroles, Campagnie Francaise des Petroles BP and Societe Shell d'Algerie to build a 40,000-bpd refinery at Algiers. The plant will treat Sahara crude and yield all major products.

Erdolchemie G.m.b.h. is building a a petrochemical plant at Dormagen, near Cologne, West Germany. The company is jointly owned by BP Benzin und Petroleum A.G. and Farbenfabriken Bayer A.G. The first unit of the new plant was completed last September. Construction is in progress on other units, and the first stage should be completed this Summer. The total investment is said to be $70 million.

Suntide Refining Co. plans to build a 7,000-bpd delayed coker at its 65,000-bpd Corpus Christi, Texas plant. Coastal Products Co. will build the $3-million unit, to be jointly owned by Sunray Mid-Continent Oil Co. and Suntide, which will be the operator. Construction will begin in April with completion slated for late 1959. Charge stock will come from Suntide refinery and other Gulf Coast plants.

Monsanto Chemical Co. has begun a program to expand production of high-pressure polyethylene at the Plastic division's Texas City plant. The 100-million-pound-per-year facility will be completed late this year. Present production is 67-million pounds.

U.S. Industrial Chemicals Co. has completed its new 25-million-pound-per-year polyethylene compounding plant at Tuscola, Ill. The plant will produce polyethylene resin with carbon black and other additives to produce electrical and pipe resins.

Collier Carbon & Chemical Co. will expand capacity of its Brea, Calif., plant by 15 to 20 percent. The program is scheduled for mid-1959 completion. C F Braun & Co is handling plant changes, and Erhart and Associates, Inc., is the contractor.

General Petroleum Corp. is planning expansion of fluid coking facilities at its Torrence, Calif. refinery. Yields of gas oil and gasoline from heavy crudes will be upped. The move coincides with Los Angeles pollution rule that prohibits burning fuel oil with more than 0.5 percent sulfur during the May-October smog season.

Coastal Products Co. plans to construct a 7,000 bpd delayed coking plant at Corpus Christi, Texas. The $3-million plant will be built on land leased from Suntide which will also operate the plant.

single

STEP

to profitable processing

If you're familiar with the one-step Houdry Dehydrogenation Process, you know the source of profit for a large share of this country's butadiene production capacity. Since the major expansion of the synthetic rubber industry began in 1955, more than 300,000 ton/yr of new capacity has been installed by Houdry licensees using this process for transforming butane to butadiene.

Don't get the idea though, that you have to make synthetic rubber to enjoy the advantages of the Houdry Dehydrogenation Process. It is also highly efficient for transforming butane to butenes, isobutane to isobutene, and other light hydrocarbons to mono- and di-olefins.

Simple . . . flexible . . . profitable. That's the Houdry Dehydrogenation Process. And it has these three very important characteristics because Houdry people designed it that way, and made it deliver.

They can do the same for you.

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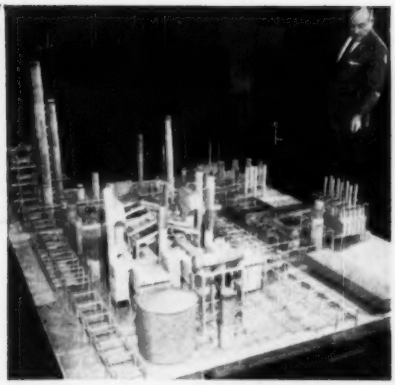
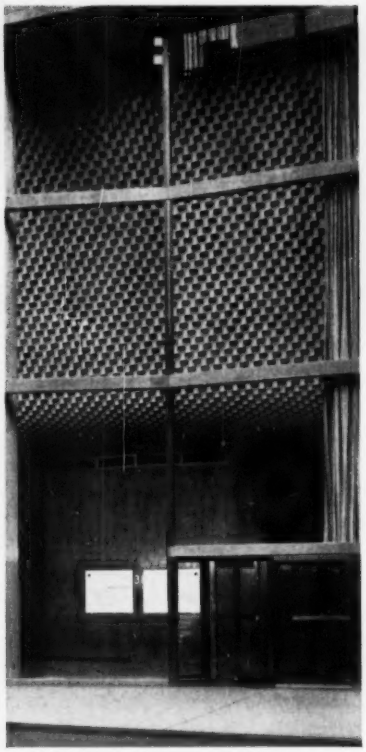
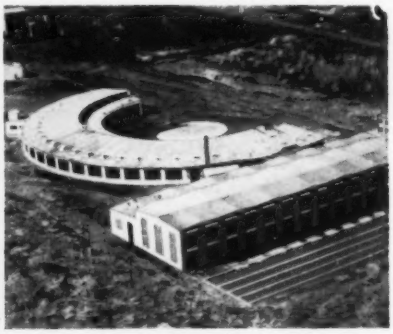
One of a series of advertisements on Lummus' world-wide facilities.



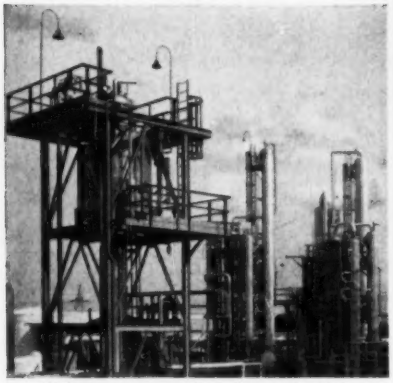
200,000,000 lb. per year ethylene plant



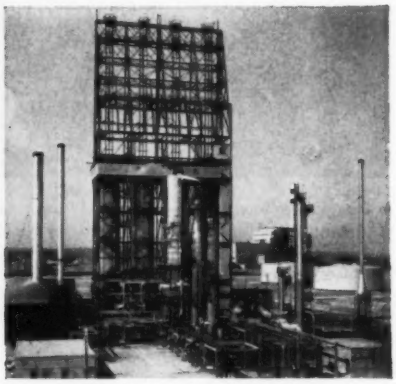
The Lummus Company headquarters
385 Madison Avenue, New York, N. Y.



Beryllium plant



High pressure acetylene chemicals plant



600 ton per day coking unit

Lummus New York is headquarters for design, engineering and construction

Engineers and Constructors of More Than 700 Refineries, Chemical and Petrochemical Plants of all Types and Sizes Throughout the World in the Last 50 years.

The Lummus Company headquarters are at the business crossroads of the world in New York, ready to coordinate the engineering skills of over 3,000 permanent employees located in seven branch offices and subsidiaries throughout the world.

A staff of more than 1,000 scientists, engineers and administrators contributes a wealth of skill and experience—each in his chosen field—to handle the great mass of detail involved in a modern processing plant. Few single companies in the process industries can afford to maintain the reserve of industrial experience and engineering skill that characterizes the Lummus organization.

In addition, Lummus maintains a 150,000 square foot Engineering Development Center in Newark, N. J., to bridge the practical gap between laboratory research findings and commercial plant operation. The Center has extensive pilot plant facilities in operation, and is equipped for designing and building new units.

Several recent domestic projects of The Lummus Company (pictured above) are: a 200,000,000 lb. per year ethylene plant; America's first full scale, high-pressure acetylene chemicals plant; a beryllium metal plant; and a 600 ton per day coking unit designed for the heaviest charge ever fed to a coker.

See Lummus on your next project.

Branch offices of The Lummus Company are located at Washington, D. C., and Houston, Texas.

Subsidiaries are in Montreal, London, Paris, The Hague and Maracaibo.

Visit The Lummus Exhibit, Fifth World Petroleum Congress Exposition, New York Coliseum, June 1-5, 1959

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ENGINEERS AND CONSTRUCTORS FOR INDUSTRY
385 MADISON AVENUE, NEW YORK 17, N.Y.

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Staff Report

Cut Down Your Employe Turnover Rate

Check over these points to make sure that some of your company policies aren't "driving" employes away

TURNOVER, ALWAYS a problem in industry to some extent, has become a matter of unusual concern today due to the high cost of recruiting and training of technical personnel.

Other costs, such as loss of effective production while the new employe is learning the job, wastage of raw material, expensive accidents, higher insurance rates and other overhead expenses, cannot be ignored either.

Of course, turnover can never be completely eliminated, but excessive rates can be reduced. This reduction is possible only when management becomes aware of the conditions and actions that cause turnover, and when corrective action is taken to alleviate the conditions and change the actions.

Needless to say, management is primarily responsible for the control of turnover. Upon careful analysis, management will find no single cure for this malady, but nevertheless some remedies can be found.

But we are about to get the cart before the horse. Before a doctor recommends a remedy for an illness he ascertains the cause. By the same token, before we latch on to some remedies for turnover, a thorough study of the "causes" is essential.

High turnover. Industrial and academic studies verify the fact that the highest incidence of turnover usually occurs during the first month after hiring. In addition, the turnover rate is higher for young employes than for the older workers.

Below are many conditions and actions that, if present, make it possible for a company to receive the White Elephant Award for the country's highest turnover rate.

1. Poor selection methods. The personnel of the employment office must first understand the job duties and requirements before they can select a worker to fill the vacancy. If they do not have such an understanding it is quite probable that many workers will be assigned to jobs for which they are not suited.

Their physical, mental and technical qualifications must be matched as closely as possible to the job duties and requirements.

If not, the misplacement can cause unrest and disatisfaction among the new workers. Discouragement follows and the workers quits in the hope of finding a more suitable job with another company.

Remedy: First, the employment interviewer must have a realistic and up-to-date knowledge of the job and its requirements. Inadequate information here will result, many times, in the hiring of under- or overqualified workers.

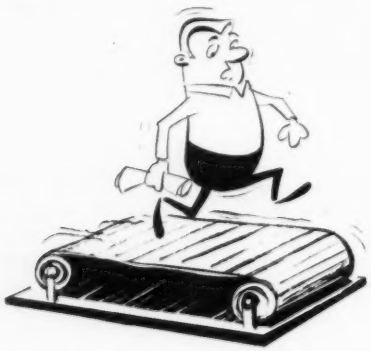
Next, many measuring devices such as aptitude, interest, and proficiency testing; physical appraisal; personality evaluation; and other techniques can be used. The goal, of course, is to get the right man in the right job.

Such evaluation will help eliminate the possibility of a worker being assigned a job below or above his skill level.

2. Poor working conditions. Poor lighting, inadequate and faulty tools, and dirty and cluttered premises all contribute to turnover. And, especially where women are employed, a lack of proper rest rooms, eating places and lounges will go far toward raising the turnover rate.

Remedy: Provide good working conditions and in-plant facilities and services. When prospective employes are shown around the premises a well-kept house with all necessary living facilities will contribute positively to their decision.

Employes like to feel proud of their working "home." Given encouragement and proper equipment by management they will tend to be happier and more content with their jobs. This, of course, is a deterrent to turnover.



3. No opportunity to advance. Staying too long on one job will cause a worker to camplain and look about for a solution. Seeing no chance for advancement or change he will go "job shopping" during lunch hour and over week-ends.

A survey of college graduates revealed that opportunity for advancement was the number one reason for selecting a particular company. Therefore, when such opportunity does not present itself, the employe will change companies.

Remedy: Never tell a prospective employe, when he asks, that he will advance if he works hard and "keeps his nose clean." This is just another way of saying that your company has no well-defined system of promotion or transfer.

To remedy the situation an employe appraisal plan should be formulated. Based upon this appraisal, along with seniority and other rights, a clear-cut, workable system can be devised for promotion.

Such a plan should be explained to the new employe. Where the job has no real future for advancement, a full explanation should be given the applicant before he is hired.

A word of caution. An overqualified, ambitious applicant may state that he is willing to take the job and will be satisfied, "Just as long as I can work for your company." Don't be deceived. He will more than likely become dissatisfied and either quit as soon as he has found another job or become a complaining, troublesome worker.

The better course is to put a "brave" in the job in the first place and send the "chief" on his way to find a suitable job with another company.

4. Hiring all "chiefs." The writer recalls a statement made by a novice in the hiring field which postulated the hiring of only the top ten percent of all applicants. Every job would be filled with highly intelligent, highly qualified employes.

His idea was to have a "super" company much like Hitler's "super" race. Of course, such a plan would never work. Instead of a "super" company, he would have a disgruntled, griping and dissatisfied company. Some "braves" are well needed to do the jobs that do not require leadership or "chief" qualifications.

Remedy: It is much safer to match the abilities and interests of the new employe to the job duties and qualifications. Employes of all intellectual levels (that is, above the feebleminded level—and sometimes one wonders if some of them have slipped through) should be hired. There's no getting around the fact that some jobs are dead-end.

An applicant with limited aptitudes and interests and of a certain temperament should be considered for one of these permanent "brave" positions. Someone who does not aspire to be a "chief."

5. Poor supervision. "I remained with this company in spite of my supervisors," was the way one executive expressed it. Other less determined and tolerant individuals would not have stuck it out.

Poor supervision contributes greatly to the turnover rate. The first line supervisors can make or break a company. A new worker needs guidance—proper guidance—for several weeks. The lack of such guidance often results in terminations.

The bad publicity the ex-employe gives the company because of the poor supervision, doesn't help matters much either.

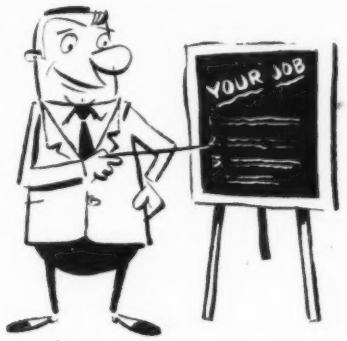
Remedy: Determine the cause of poor supervision. Are the supervisors overloaded? Are they using "old-fashioned" get-tough procedures? Are they properly trained in supervisory procedures? Are they kept adequately informed?

After determining the causes for poor supervision (which can be accomplished by inquiry and exit interviews) a training program can be set up that will provide a well-organized, properly instructed supervisory staff.

Remember, the supervisor is the "Company" to the new employe. His attitudes and policies are a direct reflection of the thinking of the com-

pany in the opinion of the worker. Therefore, to help eliminate turnover due to poor supervision, be sure the supervisor displays the correct attitude and policies.

6. Inadequate or no training program. When the new employe tries to do his job without proper training he is confused and can see little progress. If this continues, he will become disappointed and begin to think that advancement will never come.



This situation leads to low morale which in turn leads to termination. "Learning the hard way" may have been all right years ago but there is no excuse for it now. In fact, workers will not tolerate such a condition. They will seek jobs where they will be trained properly.

Remedy: Develop a well-organized training program for both new and old employes. Such programs as Induction, Orientation, Job Instruction, and Work Methods should be instigated for the new employe. Then, the following up each of these programs with individual attention is essential. The new employe's supervisor should check constantly to see if the worker is progressing satisfactorily.

The employe should be informed of his progress. Shortcomings should be noted. Questions should be answered. By letting the new employe know where he stands and how he is progressing the supervisor is helping to cut down turnover.

A well thought out training program that "leads them by the hand" for the first few weeks can go a long way toward keeping morale high and turnover low.

7. Unsound wage structure. It is surprising how much employes know about their fellow workers' salaries. Especially since the talk of wages and salaries is supposedly taboo.

Of course there are very few salary and wage secrets. Like sex, the subject is taboo but everyone knows about it. Since this is true, any discrepancy in wages will bring about hurt feelings, low morale and general grumbling. A new employe may wonder why he is making less money than another new man that is doing the same work. If there is a legitimate reason, he should be so informed. If the reason is not legitimate—well—the supervisor will just have to get himself out of it the best way he can.

Wages that do not compete with local industry can cause turnover. That "secret" information gets around too.

Remedy: Establish a job and wage evaluation procedure. Make accurate job descriptions and compare the wages for these with comparable jobs in other like industries. Base wage scales on a fair and equitable system where prejudices and favoritism will be held to a minimum.

If the wage scale system is communicated properly to the employes, management will have nothing to hide and can answer any inquiry frankly and unafraid.

The new worker, after being informed of the wage system, will feel secure in knowing exactly what to expect on the first day and at later intervals.

A challenging situation. The causes and remedies just discussed do not exhaust the subject of turnover. However, the situation produced by a high turnover rate is a challenging one.

Careful thought and action are required if the causes are to be determined and the remedies prescribed.

Obviously if the turnover problem is going to get the attention it plainly needs, a lot of planning, reorganization, and leadership on the management level will be necessary. But once management has taken the lead in this all important problem, it will be in a position to set up red lights that will stop those policies and conditions that cause the high turnover rate.

However, we should not forget that employes too must be motivated to take a vigilant interest in the problem. Then, as both labor and management develop a sense of responsibility, and participate with each other for the common good, the low turnover rate everyone desires will be achieved.

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Low Operating Pressure—High Over-Range Protection

• EXAMPLE APPLICATIONS

1. Provide low suction protection on pumps where suction pressure may go to very high line pressures (up to 2,500 psi.)

2. As an interlock to prevent a door to a pressure chamber from being opened until the pressure has dropped to atmospheric pressure (1" H2°) with over-range protection to 600 psi.

• TWO SERIES AVAILABLE

Series DA-900: Bourdon tube operated. Over-range protection to 2,500 psi. Operating ranges 0-60 psi; 0-100 psi; 0-150 psi; 0-300 psi.

Series CP: Diaphragm operated. Over-range protection to 600 psi. Operating ranges 1"-60" pressure or 1"-60" vacuum.

Both types available in various style cases-

SEND IN YOUR CONTROL PROBLEM OR WRITE FOR BULLETINS CA-21 & CA-1P

THE MERCOID CORPORATION
4211 Belmont Ave., Chicago 41, Ill.

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So You Have to Make a Speech!

If you want to really put your talk across to your audience, use these sixteen suggestions

Ernest W. Fair, Boulder, Colo.

JUST ABOUT every oil man at one time or another has to make a speech, or several of them, before a civic group, a business association meeting, a convention or what have you. And when that time comes he wants to make the best possible speech in the best possible manner.

Quite often, those who are faced with this prospect will find themselves in a real dilemma because they just don't know how to put a speech across to an audience. If you are ever in that situation, this list of suggestions will pull you through with flying colors.

It would be a good idea for you to clip this out so these pointers will be handy the next time you are preparing to deliver that prepared speech.

1. Say it your own way. If you want to avoid sounding like a stuffed shirt, speak in the same style and language you use in your everyday life; it'll come natural; any other way will be forced. If you pick up some data or information somewhere, present it in your own words, not those of the source.

2. Talk louder than you have to. Not only will you be sure to be heard clearly, but instinctively you will put more effort into what you say when you talk louder than normally.

3. Change the pitch of your voice. One pitch gets horribly monotonous. Whisper some, yell on another point and use your normal voice, but vary the pitch of your voice throughout the speech.

4. Keep your points down. You will make a much more lasting and worthwhile impression if you limit your message to three or four well emphasized points than if you attempt to "snow under" the audience with a deluge of facts and fancies.

5. Leave things alone. This means the necktie, the watch chain, the "specs" or anything else that attracts the attention of the audience from what you are saying and to what your hands are doing.

6. Look good. A good appearance means an awful lot toward getting the favorable attention of your listeners; so don't do as many business and professional men have a habit of doing—make the speech in the same clothes in which they went about their chores all day long.

7. Watch for repetition. Nothing ruins a good speech faster than constantly repeating a pet cliché or even a pet word. If it's good, it will register the first time it's heard; if not, then it is best not even mentioned that one time.

Put on a good show

8. Stand still. Stand in the same position as much as possible and don't put on a military drill in front of your audience. They are not interested in such antics and besides it detracts from what you are saying.

9. Don't droop. It pays to stand on your toes when you talk. Don't sag or relax. It also pays to remain alert throughout the whole ordeal no matter how tired you may be, and give the audience the impression that you are full of energy and rarin' to go every minute you are talking.

10. Put on a good show. Your speech should be the high point of the evening's program; do your best to see that it is. The executive who begins his speech firmly convinced that he can give a lot better speech than the "guy" who preceded him or the one who spoke last week is going to give a better speech.

11. Work hard on the ending. It doesn't pay to have a top notch speech and an excellent delivery and then have the whole thing ruined by a bad ending. Say or do something the audience can enter into, can feel a part of, and can feel that they have really heard something which was worth the time they spent listening to you.

12. Never apologize. This goes for the weather, the speech, its length, the hour, your voice, or anything else. People don't want to listen to such

HF

isn't too tough to tame

. . . Careful control does the job

Alkylation with hydrofluoric acid lowers catalyst cost per barrel of alkylate, shortens reaction time and catalyst settling time, eliminates spent acid problems and reduces acid inventory. If you've hesitated to cash in on these economies because of concern about HF's safety, here are some facts you'll want to know.

HF handling can be safe . . . as safe as the many other active chemicals in common use today. And like other chemicals, safety with HF comes from knowing how to handle and control it. That's where you can profit from over 40 years of Pennsalt experience in fluorochemistry.

Pennsalt will help you make HF handling safer through control. We're ready to give you expert technical aid on handling and storing HF . . . help you set up employee training programs . . . advise you on piping, valves and other equipment and materials that are best for HF service.

Pennsalt specializes in HF. We've pioneered in developing ways to make, ship and handle it better, safer and more economically. Pennsalt® HF is made in modern controlled-process plants to assure purity that meets or betters alkylation process needs. It is available in cylinders and tank cars of convenient sizes.

For more information, technical assistance or ordering, call or write Pennsalt today.

See our catalog in CMC

See our Catalog in Chemical Materials Catalog

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ESTABLISHED 1850

In the West, Pennsalt inorganic chemicals are available through Pennsalt of Washington Division, with plants at Tacoma, Washington and Portland, Oregon.

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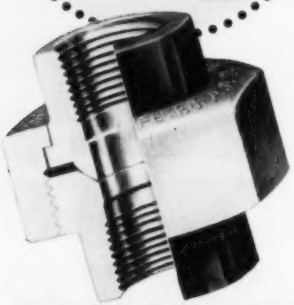
Petro® Hydro® Mark® Handlebar®

UNIONS

feature for feature are SUPERIOR

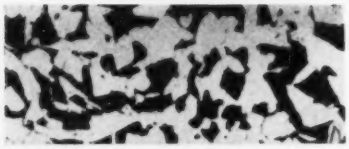


HOT FORGED —

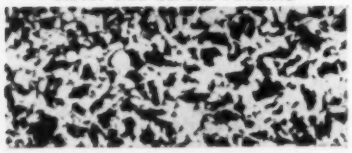
Makes parts stronger . . . another feature of CM Petro®, Hydro® and Mark® Unions. In properly forged work, such as is done at Clayton Mark, the flow of metal is in the same direction as the stresses that will be set up in service. CM Unions have their greatest strength in this direction thus making them stronger and giving better service.

INDUCTION-HEATED FOR FORGING —

Every CM Petro®, Hydro® and Mark® Union is made from metal that is induction-heated. This is an additional feature that produces finished forgings that have a finer, more uniform grain structure. There is no contamination of the surface and scale is kept at a minimum. Another hidden quality that makes CM Unions the best to specify!



GRAIN SIZE BEFORE FORGING



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Specify the brand–CLAYTON MARK!
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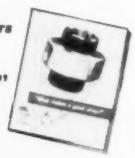
At leading Industrial Distributors in all 49 states.

Write today for free booklet "What makes a good union?"



CLAYTON MARK & Co.

1900 DEMPSTER AVENUE

EVANSTON, ILLINOIS

things, and if you call attention to some small thing, the imagination of your audience will seize upon it and magnify it. If there is anything wrong, it is better to cover up the whole business and forget it, maybe no one will notice the situation anyway.

13. Time yourself carefully. The most common mistake of the first time speaker is to go to one of two extremes. He either makes his speech too short or too long. A good point can't effectively be put over in the average speaker's short speech (few of us can ever reach the heights of Lincoln's speech at Gettysburg). While on the other hand, dragging something out only buries it in dreariness. Timing is of the utmost importance in addressing any audience.

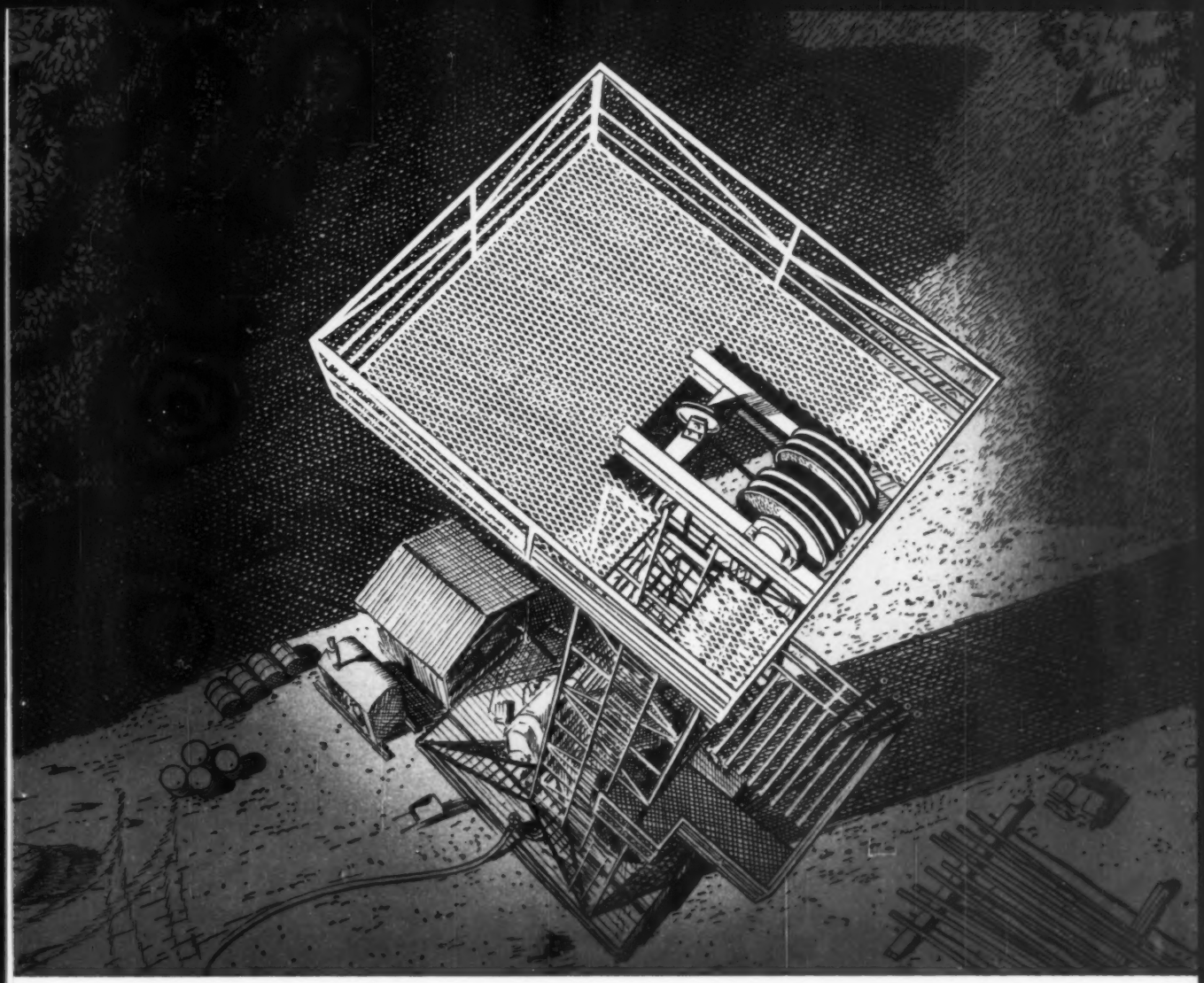
14. Be careful of jokes. A joke which has no point in your message doesn't belong there. If you must pull 'em, make sure they are well placed, well told and have some relation to your speech. Avoid dialect jokes—it takes an expert to put them over.

15. Surprise your audience. An unusual twist in the process of speech making always wins an audience's friendliness. For example, one speaker we knew stood on the platform leafing through some 100 typewritten pages of notes as he was being introduced. We all groaned inwardly at the prospect of a long and very dull speech ahead of us. Instead, the speaker looked straight into his audience and remarked that he was sure no one was interested in what he had worked up for a speech, threw the whole batch of typewritten paper into the wastebasket, and proceeded to give one of the best informal speeches we have ever heard.

16. Be sure of pronunciation. All of us have a habit of mispronouncing a few words and are usually never aware of what we are doing. However, when these are so spoken in even a speech before a small audience, they stand out like the well known "sore thumb" and can ruin the whole receptiveness of an audience.

These 16 suggestions accomplished the task for one "amateur speaker"—they can be of as definite assistance to any other person who finds himself confronted with what used to be a terrifying assignment to speak before a large audience. ##

For more data on advertised products, use Readers' Service Cards, last page.



RIGHT...from the top down

A good, dependable water supply system is no better than its beginning. The best beginning is a Layne drilled water well. Layne is the largest water well drilling organization in the world with over 75 years experience. Trained crews operate over 500 drilling and service rigs throughout the country.

Layne service doesn't stop there. A dependable Layne Pump specially designed for the job to deliver a specified QUANTITY of water, and Layne water treatment service to supply the exact QUALITY of water desired, are part of a complete job with undivided responsibility. But, that's not all. Layne maintenance and repair service wraps up the complete package. Your nearby Layne Company is as close as your telephone, so, call on Layne for a dependable water supply, right . . . from the top down, all backed by Layne Research.

LAYNE & BOWLER, INC., MEMPHIS
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WATER WELLS • VERTICAL TURBINE PUMPS • WATER TREATMENT

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WELL DRILLING
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Operate Direct Fired Heaters Safely

Here's how a fire caused Magnolia to revamp some of its methods of handling and operating direct fired heaters

Paul W. Taylor
Magnolia Petroleum Company, Dallas

A RECENT FIRE at one of Magnolia Petroleum Co.'s plants has resulted in the revamping of certain shutdown procedures, routine operational procedures, and employe training with respect to direct fired heaters. Here is a short history of the fire which brought about some of the instructions and testing procedures outlined in this article.

About 6.30 p.m. one evening, the operator on duty noticed that the oil heater (direct fired horizontal tube type) was not functioning properly. He also noticed:

1. The appearance of the furnace fire was not normal.

2. The burners were fired properly but smoke was issuing from the stack.

PIPE HEATER INSPECTION

	TOURS					
	Daylight		Evening		Morning	
	Found	Left	Found	Left	Found	Left
1. Exterior of Heater						
a. Burned spots on paint						
b. Air leaks into furnace thru cracks, etc.						
c. Smoke coming from stack						
d. Oil drips or seeps around bottom of heater						
e. Is weep hole clear on steam snuff line						
2. Interior of Heater						
a. Refractory failures or damage						
b. Internal structure failure; bent metal, lost bolts, etc.						
c. Tube Distress						
1. Bulges or blisters on tubes						
2. Red or white hot spots						
3. Sparks flying from hot spot						
4. Sagged or warped tubes						
5. Leaks of any kind						
d. Flame pattern						
3. Instruments, Recorders and Controls						
a. Oil temperature in						
b. Oil temperature out						
c. Fuel to burner pressure						
d. Stack Temperature						
e. Is temperature controller controlling?						
f. Is oil flow high, low, or normal?						
g. Is oil flow fluctuating?						
h. Is fuel rate or pressure fluctuating?						
i. Pressure drop through oil tubes						

(Date) _____ SIGNED: _____ OPERATOR

_____ _____ OPERATOR
APPROVED SUPERVISOR

_____ OPERATOR

FIGURE 1—Special report used for inspecting direct fired heaters every four hours.

3. The fuel rate of consumption was approximately one-half normal with oil rate of flow and temperature normal.

He correctly diagnosed the trouble as a leaking tube. The leaks did not seem to be increasing so he called the superintendent, the foreman, etc., at 8:15 p.m. All burners were shut off and snuffing steam turned on. By 8:20 p.m. all gas fires were out but oil was still burning in fire box. Oil circulation continued but temperatures were being maintained by the oil fire.

At 8:40 oil circulation to and from heater was shut off, and area was cleared of personnel.

At 8:50 an explosion and flash fire occurred in heater.

Subsequent examination showed that there had been a one-quarter inch diameter hole in one of the tubes. This supplied the fuel for the fire but was not large enough to relieve the excess pressure caused by the shut-in oil system and the heat from the burning oil. This pressure caused another tube to rupture which caused the explosion and flash fire.

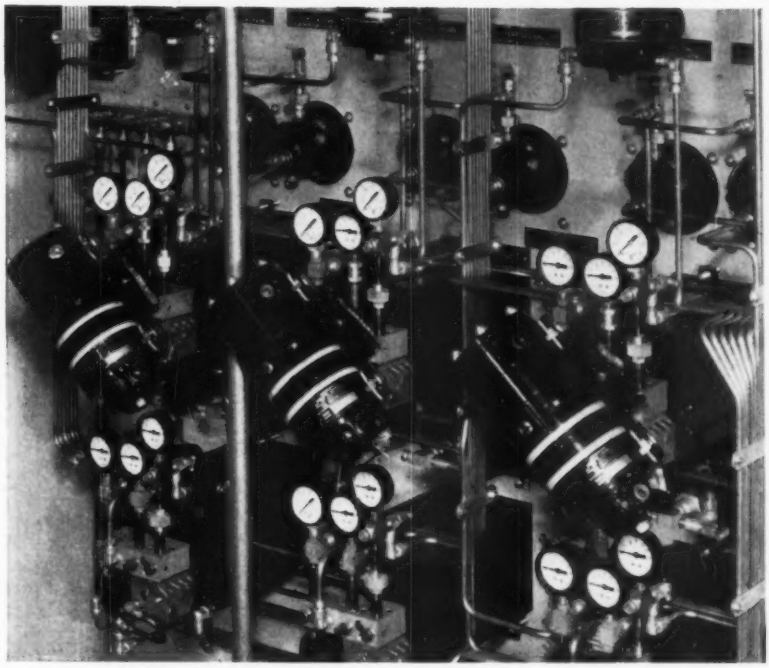
Since that fire Magnolia has considerably revised its instructions for emergency shutdowns. Today's typical instructions for emergency shutdowns are as follows:

1. Turn crank on one of two emergency manual shutdown controls. (Laboratory door and one on southeast corner of engine room building). These are color coded red.

2. Gradually open heater emer-

IMPERIAL Engineering and Data File

ENGINEERED TUBE FITTINGS — VALVES — TUBING TOOLS

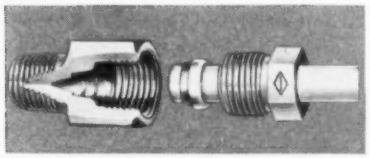


Leakproof connections quickly made with Hi-Duty tube fittings on refinery control boards

Tube fittings that assemble to tubing fast and provide assurance against leaks are one of the top requirements for control boards.

That's why Panellit selected Imperial Hi-Duty fittings on this panel board used for automatically controling a variety of oil refinery processes.

Hi-Duty Fittings have a one-piece nut and sleeve. A joint is made simply by pushing tube into fitting and tightening nut. Sleeve shears off and becomes permanently attached to tube. One man can easily assemble up to four Hi-Duty fittings in the time it takes to assemble one flare fitting. Hi-Duty assembles one-third faster than compression fittings and can be disconnected and reconnected repeatedly without leakage. And they withstand five times as much vibration as compression or flare fittings.



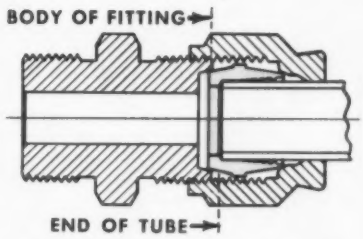
Disassembled Hi-Duty Fitting shows how sleeve has become permanently attached to tube.

Write for Bulletin No. 3002

HOW HI-DUTY SAVES 36% TO 72% ON INSTALLATION TIME!

TYPE OF FITTING	AVERAGE TIME FOR EACH JOINT	JOINTS PER HOUR
HI-DUTY	11.7 sec.	307
Regular compression	18.5 sec.	194
Flare	48.2 sec.	74

These studies were made under actual shop conditions.



Limited space? Solve it with Hi-Seal Fittings

Exclusive design of the Hi-Seal body, sleeve and nut creates the perfect butt joint . . . without threading or flaring. This butt joint is ideal for close quarters . . . the tube swings into place without springing or dismantling other components.

Because no flaring is necessary with the Hi-Seal butt joint, bends can be made exceptionally close to the ends of the tube . . . another major benefit where space is limited.

Key to high performance, even under high pressure conditions, is the sleeve with its base shoulder and 3 radial serrations. Camming action of nut causes sleeve to form a collet-type, triple seal grip on tube. Fittings meet J.I.C., A.S.A. and A.S.M.E. standards.

These fittings are available in stainless steel, steel and brass. Hi-Seal stainless steel fittings resist corrosive atmospheres and conditions of corrosive liquids and gases at high pressures.

Write for bulletin 3061

Free handbook tells how to work with tubing

This practical book tells you how to cut, flare, bend, swage, ream and solder tubing . . . fully describes modern tube-working practice.

Handbook No. 369

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For more data on advertised products, use Readers' Service Cards, last page.

SPECIFICATIONS FOR DIRECT FIRED PROCESS HEATERS

Heater Control and Instrumentation

a. An orifice and flow recording controller will be installed in the oil line to the heater to shutdown heater in the event of high or low oil flow rate.

b. If the heater has two or more banks of tubes, orifices with flow indicators will be installed in the line to each bank, in addition to the basic flow recorder mentioned above.

c. Thermometers will be provided in outlet of each bank.

d. Fuel gas to heater will be controlled by a pneumatic motor valve operated by a temperature recording controller on the composite oil steam from the heater.

e. High stack temperature shutdown device will be a temperature transmitter and indicating fixed high sensitivity indicating control. Pneumatic signal will operate pressure switch in control circuit of shutdown devices.

f. Pilot flame failure shutdown device will be a conductivity-rectification type with pilots. Two or more pilots and relays may be required, depending on the type of heater used, and number of main burners installed.

g. A 5-minute manual set time delay switch shall be incorporated in the flame failure shutdown circuit to facilitate lighting off.

h. A 10-15 minute manual set time delay switch shall be incorporated in the high and low flow shutdown circuit to aid in getting steady flow established without shutting down the heater.

i. Heater shutdown will be according to the following schedule:

	Shut Off Fuel Gas	Shut Off Oil Flow Valve	Shut Off Heater Oil Circ. Pump	Turn On Snuff Stm.	Sound Alarm	Light Signal
High Stack Temp.	Yes	Yes	Yes	No	Yes	Yes
High Oil Flow	Yes	Yes	Yes	No	Yes	Yes
Low Oil Flow	Yes	No	No	No	Yes	Yes
Flame Failure	Yes	No	No	No	Yes	Yes
Power Failure	No	No	No	No	Yes	No
Air Failure	Yes	Yes	Yes	No	Yes	Yes
Heater ESD	Yes	Yes	Yes	Yes	Yes	No
Plant ESD	Yes	Yes	Yes	Yes	Yes	No

Emergency Dump System

a. A dump line will be provided on the outlet of each bank of direct fired heater tubes. The purpose of which is to empty the heater tubes of fluids in an emergency.

(1) The dump line connections will be upstream of heater outlet block valves and check valves.

(2) The dump line will serve no equipment other than the direct fired heater.

(3) The dump line will terminate in a blow-down tank remote from the heater and all other equipment and working areas.

(4) The top connection of the blow-down tank shall go to the flare stack and the bottom connection will go to the burn pit.

(5) An easily accessible gate valve in the dump line located remote from the heater will be used for the dump valve.

(6) Provision will be made for expansion of the dump line.

b. A 2-inch steam connection for flushing will be made on each bank of heater tubes inside of inlet block valves.

(1) The steam source will be at a higher pressure than the normal working pressure of the heater but will not exceed M.W.P. of heater.

(a) The flushing steam block valve will be a gate valve located remote from the heater.

(b) A steam trap will be located upstream of the flushing steam block valve. An eighth inch weep hole will be downstream of the block valve.

(2) At the heater tube the steam connection will have a gate type block valve upstream of which will be a check valve. The block valve will be locked open.

Snuff Steam

a. A snuffing steam line with a pneumatically operated motor valve located remote from the heater will be connected to all connections provided by the heater manufacturer.

(1) 2-inch snuff steam lines will be connected to the combustion area; 1-inch snuff steam lines will be connected to header box compartments.

(2) A steam trap will be located upstream of the motor valve.

(3) A ¼-inch weep hole will be provided immediately downstream of snuffing steam motor valves.

gency dump valve to full open position (on sidewalk northeast corner of auxiliary building).

3. Close circulating pump discharge.

4. Close valve on hot oil from heater to still, only when the heater pressure is below the still pressure.

Also, training programs and routine operation procedures have been revised. Every man who either regularly or temporarily operates heaters is thoroughly trained in the routine and emergency shutdown procedures before he is allowed to operate. In addition to the routine temperatures and pressure records that formerly required noting every 4 hours, we now require a special inspection report for the heaters (Figure 1).

At least once each tour, operating personnel charged with the responsibility of oil heater operations, will make visual inspection of the heater and related equipment. Any irregularity found calls for notification of foreman and immediate shutdown of heater if serious enough. The inspection and reporting procedure covers but is not limited to these items:

Lining Inspection (Through Inspection Ports)

1. Broken, loose or missing bricks.

2. Cracked and missing plaster in those heaters with panel-type lining.

3. External burn spots on the casing indicating heat loss through refractory.

Tubing Inspection (Through Inspection Ports)

1. Bulges and/or blisters.

2. Hot spots (red hot metal, excess heat scale and/or sparking).

3. Sagging tubes (in horizontal heaters).

4. Warping tubes or misalignment of tubes (in vertical heaters).

5. Any sign of leaks.

Instrument and Control Inspection

1. Any deviation from regular control recordings which could indicate the oil temperature is being raised by some heat other than the fuel gas; such as, oil temperature being high when at the same time the fuel gas flow is normal or low.

2. Low or high flow of oil, tem-

12345 67890

S&J High Speed Telepulse–
Error-Free Remote Reading:
Level-Temperature-Pressure

New S & J High Speed Telepulse gives remote readings in English, decimal or metric systems. Only 12 seconds for *complete* gaging cycle, including automatic selection confirmation of user's tank numbers. Other process variables transmitted with similar accuracy and speed. New Error Check circuit makes S & J Telepulse immune to error from equipment malfunction or transmission line failure. Remote control of motors and valves also possible for reporting "on," "off," "open," "closed" conditions. Building-block design provides flexibility for expansion. Plug-in construction and high-reliability components simplify maintenance. 100% digital S & J High Speed Telepulse readily adapted to datalogging and automatic data processing. Write for descriptive technical bulletins.

SHAND AND JURS COMPANY
2600 EIGHTH STREET • BERKELEY, CALIFORNIA

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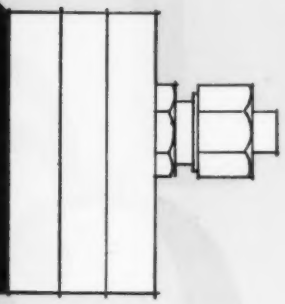
off-the-shelf pumps just right for your requirements



Whatever you want in a pump – for hydraulics, for flow or process control, there is likely to be an Eastern ready-made unit . . . made-to-order for your needs.

CAN YOU USE THESE PUMP FEATURES:

- ☐ corrosion resistant construction for chemical solutions?
- ☐ ability to handle organic and inorganic fluids at various temperatures with flows up to 70 GPM, pressures to 65 psig?
- ☐ available with open, enclosed or explosion proof motors?
- ☐ compact lightweight units with or without motor?
- ☐ high efficiencies in handling hydraulic oil, fuel and lubricants at high pressures?
- ☐ flow rates from 0.1 to 9.8 GPM, pressures from 0 to 1500 PSI?
- ☐ self-priming operation with non-lubricating liquids?
- ☐ high pressure outputs with small, low power units... and no contamination of fluid?
- ☐ flow rates from ½ GPM to 5½ GPM, pressures from 30 to 200 PSI?

An EASTERN CENTRIFUGAL PUMP MIGHT BE JUST RIGHT FOR YOU!

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Look into EASTERN HYDRAULIC PUMPS!

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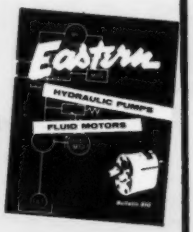

Get to know more about EASTERN POSITIVE DISPLACEMENT PUMPS!

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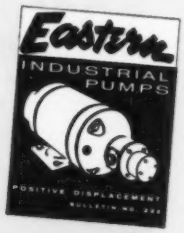

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EASTERN INDUSTRIES PUMP DIVISION

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100 SKIFF STREET, HAMDEN 14, CONN.

perature of oil, fuel consumption and stack temperature could give advance warning of abnormal conditions.

3. There is a possibility of a gradual coking of tubes which might be indicated by an increase in the pressure loss through the heater tubes.

4. Instruments should not be taken out of service, by-passed or left inoperative without proper notice to plant foreman. Instruments are mechanical and can only protect personnel and property when they are in service and in proper working condition.

Stack Inspection. Smoking from stack would indicate improper combustion or oil leaking into the fire box (stack temperature covered earlier).

Steam Out or Snuff Line Inspection. The weep hole in the steam line, down-stream of block valve (between block valve and check valve), is there to remove the condensation from the blocked-in line. The weep hole should be open at all times, making sure it is not plugged off.

General. In addition to these precautions we have a program of inspection providing that periodically (depending on the service) each heater will be shutdown and inspected generally as follows:

After a heater is taken off the line and cooled, the plugs are pulled and the tubes inspected for coking. The tubes are then cleaned of all coke. After the coke is removed the tubes are inspected by the following methods.

1. Visually for excessive bags, bulges, or blisters.

2. Inside diameter is miked with electric diameter gauge which measures the inside diameter in 2 directions. This test will bring out any bulges caused at hot spots, etc.

3. A fixed outside caliper is also used to detect bulges and blisters on the outside.

4. Any hot spots or bulges that are apt to be thinned down are checked with some type of ultrasonic testing equipment.

5. Tubes with return bends are hammer tested and ultrasonic tested. If thought necessary, bends are cut off and inspected.

6. Certain tolerances for safe retirement of tubes are set up for each installation.

Summarizing what has been covered, the program has five major features as follows:

1. Construction features are such to insure that automatic controls prevent firing heaters until normal oil flow is established, and shut off the fuel supply and oil flow to heater in case of operational upsets. Check valves are installed in all oil lines from the heater to prevent backflow.

2. Routine and emergency shutdown procedures are outlined and posted for each heater.

3. Special routine in-service inspection procedures are outlined and posted for each heater.

4. A special educational program has been instituted for oil heater operations, stressing the importance of the inspection and the memorizing of the emergency procedures.

5. A regular shutdown and thorough inspection of each heater by the mechanical engineering maintenance group.

Originally presented before the Panhandle Plains Regional Meeting of the Natural Gasoline Association of America, Amarillo, Texas, Nov. 21, 1958. # #

About the Author

Paul W. Taylor is superintendent of personnel and safety for Magnolia Petroleum Co., Dallas. With the company for 22 years, he started as a service station salesman in 1933, and successively held positions as a Natural-Gas-department laborer and plant operator. In 1947 he was transferred to Vanderbilt District in South Texas on a gas measurement assignment and remained in that type of work until 1949, when he became a plant foreman at Smackover, Ark., a position he also held at Ulysses, Kan. In 1952, Taylor was transferred to Dallas where he was assistant to the superintendent of personnel and safety until attaining his present position in 1954.

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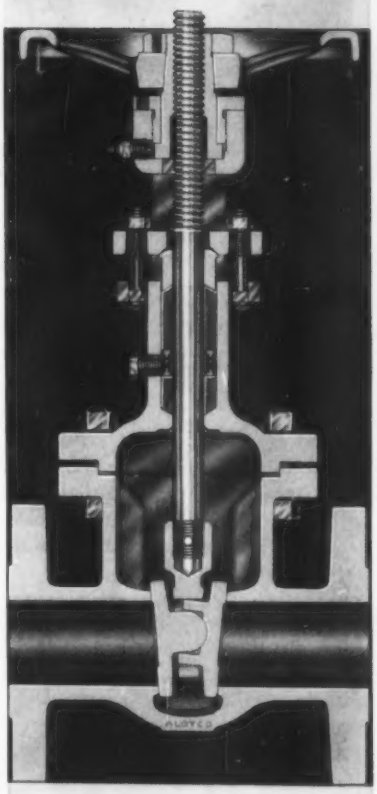

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API Refiners to Meet in New York

Midyear Refining division meeting will feature processes, with four sessions on advanced technology

An all-time attendance record may be in making for the 24th midyear meeting of the American Petroleum Institute Division of Refining in New York City, May 27-29.

On the 1959 program are group sessions on corrosion, instruments, analytical research, processes, training, petroleum products, electric power, fundamental research and safety. Major emphasis is on processes, with four sessions devoted to new developments and advanced technology.

Because the refining meeting will be held prior to the Fifth World Petroleum Congress, which opens in New York on Saturday, May 30, it is anticipated that many foreign oil men and scientists will bolster the American attendance substantially.

Present indications are that attendance will exceed 2,000. The previous peak for a midyear meeting was chalked up at Houston in 1954, when 1,902 registered.

Sessions will be held three days this year, instead of the usual four. Also, the meeting is late in the week, rather than early. This was done to complete the tie-in with the Fifth World Petroleum Congress.

A list of sessions and topics follows.

CORROSION

1. Electrochemical Studies of the Fundamental Mechanism of Corrosion Inhibition—The Adsorption Properties of Aromatic Amines, Erik Blomgren and J. O'M. Bockris, University of Pennsylvania.
2. Stresses in Clad Steels in High-Temperature Corrosive Environments, William H. Funk, Lukens Steel.
3. Sulfide Scaling Under Hydrorefining Conditions, W. H. Sharp and E. W. Haycock, Shell Development.
4. Aluminizing Resists Sulfidation and Oxidation, G. F. Tisinai and C. H. Samans, Standard (Ind.)

INSTRUMENTS

1. Refinery Instrumentation—A New Installation Guide by the American Petroleum Institute, R. R. Proctor, Pure Oil.
2. Application of Systems Engineering to a Fluid Catalyst Cracking Process Control Problem, R. E. Hall, Esso R & E; G. K. Tucker, Minneapolis-Honeywell.
3. Analogue Computer-Controller for Capacity Control of a Distillation Column, R. L. Martin and W. O. Webber, Humble; J. F. Pink, Southwestern Industrial; J. T. Hargett, Electronics.

PROCESSES

1. A New Approach to Blending Octanes, W. C. Healy, C. A. Maassen and R. T. Peterson, Ethyl.
2. Optimal Utilization of Byproduct Hydrogen in an Integrated Oil Refinery, G. T. Gwin, Humble.
3. Liquid Hydrocarbons—Another Source of Hydrogen, J. C. Yarze, T. E. Lockerbie, J. A. Finneran and P. J. Lombardi, M. W. Kellogg.
4. Processing Crude Oil at Low pH, J. A. Biehl and E. A. Schnake, Ohio Oil.
5. Guiding Refinery Operations with Small Automatic Pilot Plants, W. M. Miller, Tidewater.
6. New Developments and Techniques in Delayed Coking, V. Mekler and M. E. Brooks, Lummus.
7. Use of the Udex Process for Refinery Octane Balancing, D. B. Broughton and H. W. Grote, Universal Oil Products.
8. Expansion of Sulfuric-Acid Alkylation for Motor Fuel Production, A. R. Goldsby and D. K. Beavon, Texaco Development.
9. Electrostatic Desulfurization of Reformer Feed Stocks, R. J. Phillips and H. G. Napier, Howe-Baker.

TRAINING

1. The Aims and Objectives of the Committee on Training of the Institute's Div. of Refining, W. E. Bennett, Cities Service.
2. The Human Side of Enterprise, D. McGregor, MIT.

PETROLEUM PRODUCTS

1. A Decade of Progress in Motor Fuels, W. J. Sweeney, Esso R & E.
2. A Decade of Progress in Lubricants, A. L. Lyman and F. W. Kavanagh, Cal Research.
3. A Decade of Progress in Petrochemicals, J. H. Forrester, Amoco Chemicals.

ELECTRIC POWER

1. Purchased Power Saves $200,000 for Sohio, R. W. Mills, Standard (Ohio).
2. Joint Refinery-Utility Installations for Electric Power, Steam and Fuel Exchange, E. J. Hess, Esso Standard; V. E. Kilpatrick and G. H. St. Onge, Esso R & E.
3. Planning Economical Refinery Electric Power Distribution, K. N. Thompson, Socony Mobil.
4. Electric Motors in Petroleum Refineries, L. B. Eddy, Universal Oil Products.

PROCESS SAFETY

1. Development of Safe Procedures, American Oil.
2. Are Standard Procedures the Whole Answer?, Texas Co.
3. An Appraisal of Protective Equipment for Process Units, Shell Oil.

OIL PROCESSES & REFINING

1. How to Predict Reactions in Catalytic Reforming of Naphthas, Standard (Ind.)
2. Studies on a Commercial Two Stage Catalytic Cracking Plant, Shell Oil.
3. Refinery Studies by Digital Computer, Tidewater.
4. Extraction of Aromatics with Sulfolane, Shell Development.
5. Gasoline Refining Using Adsorbents Selective for n-Paraffins, Standard (Ohio).
6. Elementary Processes of Mass Transfer in Extraction, Absorption and Distillation, Institute of Chemical Tech. (Germany).

CHEMICALS FROM PETROLEUM & NATURAL GAS

1. Two-Stage Process for Production of Naphthalene and High Octane Gasoline from Cycle Stock, Sinclair Laboratories.
2. The Production of Synthesis Gas by Partial Oxidation, Texas Co.
3. Recent Developments in the Oxo Process, Gulf R & D.
4. Synthesis of Higher Aliphatic Alcohols by Direct Oxidation of Paraffinic Hydrocarbons, Professors A. N. Bashkirov and V. V. Kamzolkin (U.S.S.R.)
5. A New Process for Oxidation of Aromatics, Standard (Ind.)
6. Production of Aromatic Dicarboxylic Acids, Koninklijke/Shell Laboratorium; N. V. de Bataafsche Petroleum (The Netherlands).

CHEMICALS FROM PETROLEUM & NATURAL GAS

1. Acetic Aldehyde as Raw Material for Acrylonitrile, The Knapsack Process, Knapsack Griesheim AG, Germany.
2. Detergent Alkylsulfonates Derived from Petroleum Hydrocarbons through Hydroperoxides, Kadimah Chemical (Israel).
3. New Plastics from Petroleum, Montecatini (Italy).
4. Polymerization of Acetylene and Homologs, Phillips Petroleum.
5. Improved Process for Sulfur Recovery from Refinery Gases, Atlantic Refining.
6. Integration of Petroleum Chemicals Operations, Imperial Chemical Industries (Britain).
7. Development of German Multifuel Diesel Engines and their Significance, Battele Institute, Frankfurt, Germany.

UTILIZATION OF PETROLEUM PRODUCTS

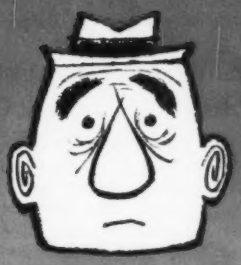
1. Advances in Gas Turbines and Free Piston Engines and their Effect on the Petroleum Industry, Texas Co.
2. Economic Aspects of Raising Compression Ratio and Octane Quality, Standard (Ind.)
3. Dynamics and Control of Distillation Columns, Koninklijke/Shell Laboratorium; N. V. de Bataafsche (The Netherlands).

ENGINEERING EQUIPMENT AND MATERIALS

1. Some Aspects of Corrosion Prevention in a Refinery, British Petroleum (Britain).
2. Advances in Process Plant Engineering, M. W. Kellogg.
3. Use of a large Computer in Making Economic Designs, Esso R & E.
4. Fire Protection in Petroleum Industries, Ing. H. Brunswig (Germany).
5. Noise Problems in a Large Refinery, Esso Petroleum (Britain).

OPERATIONS RESEARCH STATISTICS & EDUCATION

1. Petroleum's Contribution to Modern Soicety, Hamline University.
2. Basic Factors that Will Shape Future Oil Requirements and Supplies, W. J. Levy.
3. The Future Energy Requirements of the World and the Importance of Petroleum as One of the Forms of Primary Energy, P. R. de Ryckere (Belgium).



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4. Current Economic Trends in Size and Location of Refineries, P. H. Frankel (Britain).
5. Mathematical Tools in Optimization of Operations, Tidewater.
6. Information Research—A New Tool for Petroleum Progress, Esso R & E.
7. Higher and Secondary Petroleum Education in the Soivet Union, Professor K. F. Zhigach (U.S.S.R.)

SYMPOSIUM ON THE APPLICATIONS OF ATOMIC ENERGY TO THE PETROLEUM INDUSTRY

1. Probable Impact of Atomic Energy on the World Petroleum Industry, Dr. Robt. E. Wilson.
2. The Use of Short-Lived Tracers in Petroleum Applications, Tracerlab.
3. Radiation Promoted Hydrocarbon Reactions, Esso R & E.

Hydrocarbon Liquid Fuels To Be Sought From Coal

The Consolidation Coal Co. and The Standard Oil Company (Ohio) have agreed to undertake a joint basic research project to explore methods of manufacturing hydrocarbon liquid fuels from coal. The agreement is based on experience of the two companies working together in a jointly owned affiliate, the Mountaineer Carbon Co., Cresap, W. Va. Standard expects to begin active participation in its Research center and Process and Product Development division laboratories during 1959.

The company says 5 to 10 years of research and development will be required before the project will enable consideration to commercial possibilities.

Craftsman's Association Establishes New York Office

Overseas Craftsman's Association, has established a New York office. OCA is a non-profit service organization representing a membership of top management, engineering, administrative and crafts personnel specializing in construction, engineering and mining and petroleum projects abroad. The organization provides the members with a world-wide news service on foreign employment with American contractors in their respective fields. It works in close cooperation with major contractors in meeting their employment requirements for experienced and qualified personnel.

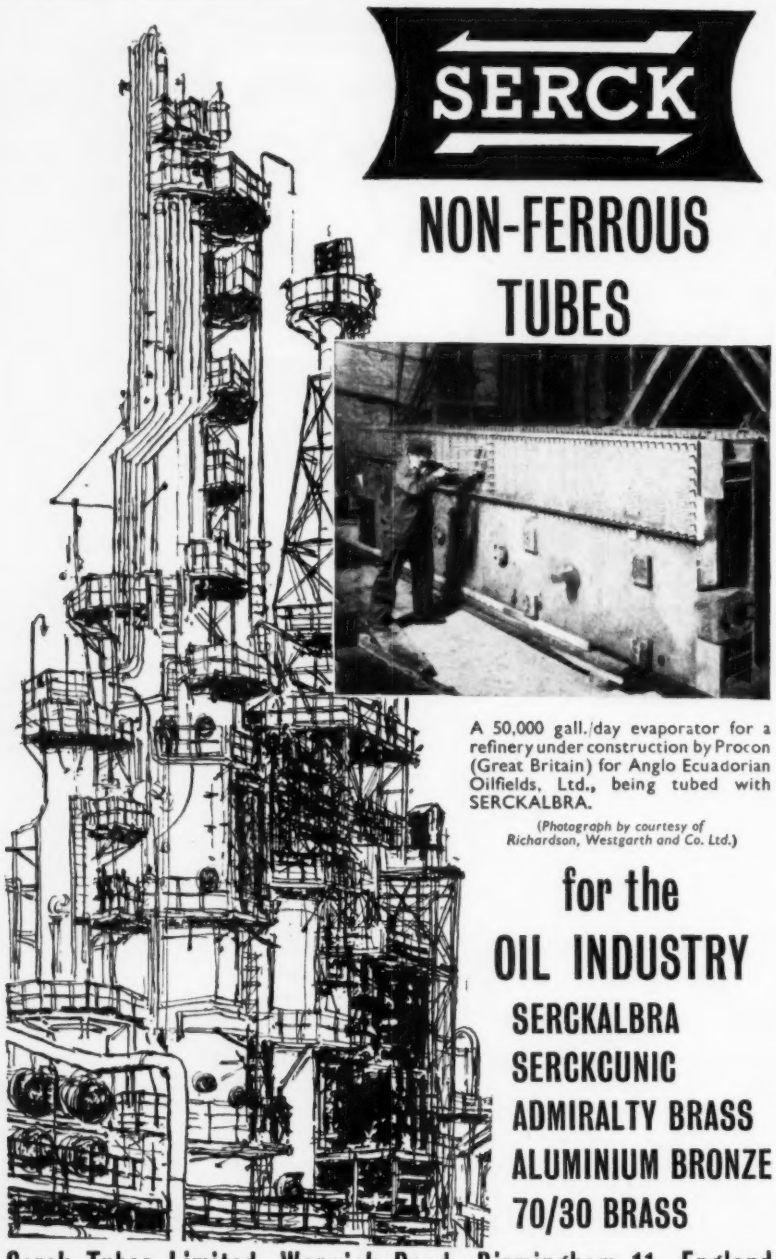
Tech Writing Institute Held at Los Angeles

The Third Annual Technical Writing Institute, combined with a course in technical writing techniques for engineers, was held in Los Angeles February 12. Director and chief instructor was John L. Kent, advertising and public relations manager, Datex Corp., Monrovia, Calif. Kent says engineers can improve their writing and increase readability by substituting the more common Anglo-Saxon words for Latin-derived ones.

Every profesional writer knows that his writing is improved when he uses simpler words, but the engineer, who has more reason to make an effort to be understood, neglects this easy way to better writing, the author points out.

"Using short words is one way to get high readability and understandability into technical matter. Additionally, showy language, like showy clothes, is in bad taste. This showy language—long, involved words and elegant phrases, fools no one. It certainly does not fool the editor," Kent writes.

"The engineer-writer has a peculiar



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NON-FERROUS TUBES

A 50,000 gall./day evaporator for a refinery under construction by Procon (Great Britain) for Anglo Ecuadorian Oilfields, Ltd., being tubed with SERCKALBRA.

(Photograph by courtesy of Richardson, Westgarth and Co. Ltd.)

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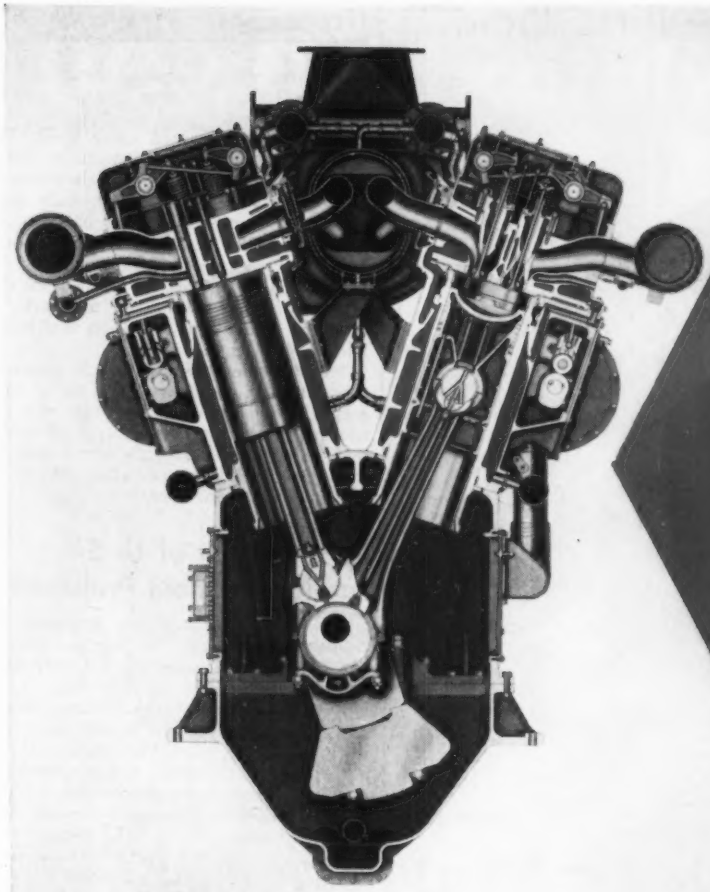

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Happenings

reason for using common words where possible. In his sentences he must necessarily use many long scientific terms. Since he cannot avoid using these, he can best "lighten" his sentences by using all the easy words he can elsewhere."

"A long word is not particularly objectionable simply because it's long," Kent states. But he asserts that if a short word that conveys the same meaning is available, why not use it? "Repetition of a short word does not divert the reader's attention as much as repetition of a long one," he claims.

"Most engineering writing is expository. It aims to explain. To do so effectively, this writing must be direct, specific, and clear. For this type of writing the engineer should use words which cannot be misinterpreted—short and simple ones," he concludes.

Investigation of U. S. Foreign Business Problems

An investigation into "the problems of American companies in foreign fields, particularly where monopoly is involved," is planned for 1959 by Sen. Estes Kefauver, chairman of the Senate Antitrust subcommittee. The senator said "it is the belief of the subcommittee that historically much of the nation's foreign policy has been entwined with the operation of American companies abroad. As the continuing threat of seizure of American companies' property abroad persists, it is desirable to develop a consistant policy by government agencies to assure continued health of American foreign commerce."

Rubber Demand to Rise 13% In 1959, Says Association

A 13 percent gain in rubber consumption during 1959 has been forecast by the Rubber Manufacturers Association. While 1958 figures are not complete, it appears that consumption was about 1.3 million long tons, compared with a 1.5-million-ton estimate for 1959. "Manufacturers of consumer-type rubber products did well in 1958," says the Association.

November LPG Output Up Says Bureau of Mines

November LPG production averaged 35.3 million gallons per day, an increase of one percent over November, 1957, according to the Bureau of Mines. Daily average production at refineries was 6.7 million gallons, up 17 percent. Daily average demand for LPG for fuel and chemical uses was 21.9 million gallons, down 6 percent.

LPG stocks totaled 923 million gallons at the end of November, while under-

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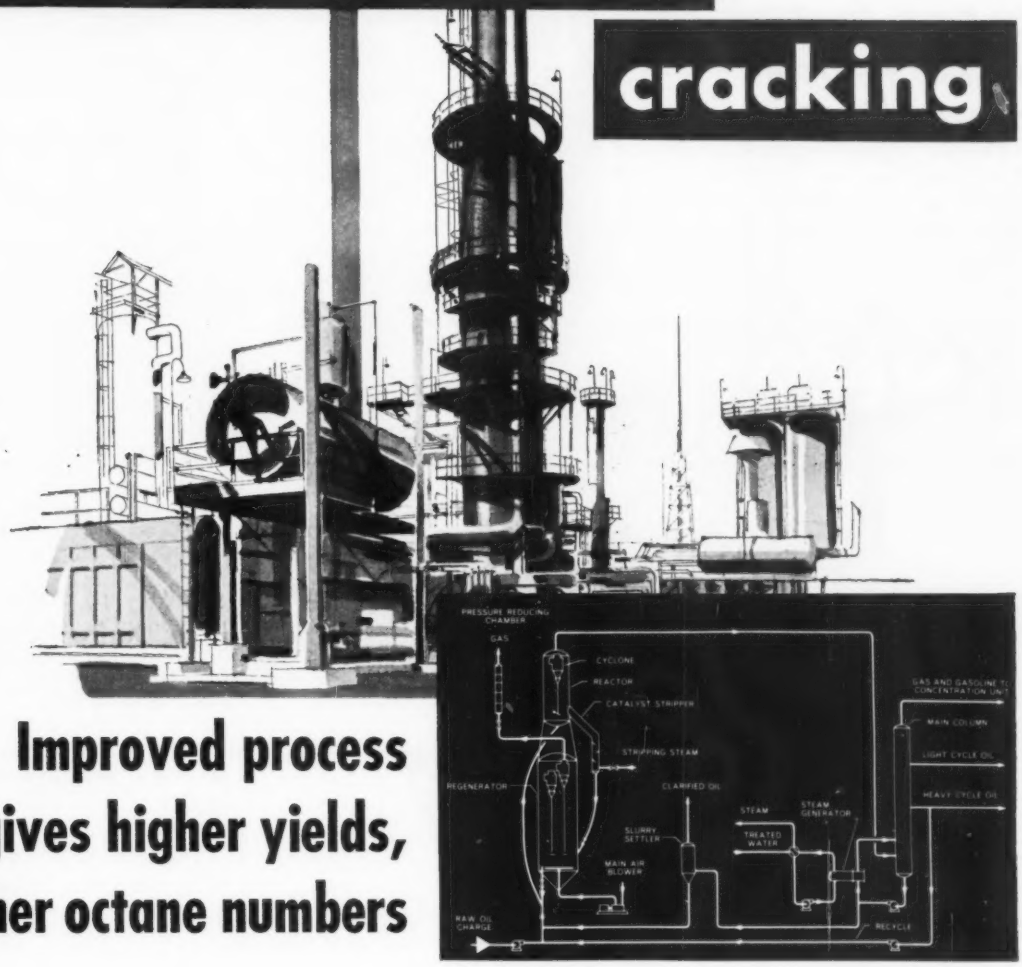
UOP fluid catalytic cracking



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Widely applied to refinery operations, UOP Fluid Catalytic Cracking offers a convincing record of proved performance.

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ground stocks of liquefied gases totaled 698 million gallons. Daily average demand for natural gasoline was 10.9 million gallons, down 4 percent from November, 1957.

Refinery Yields Ratio Poor, Says Sinclair Exec

Current refinery operations are threatening "the improved 1959 outlook for petroleum products," according to the latest industry statistics, says Thomas B. Kimball, president, Sinclair Refining Co. "Ignoring the obvious economics of the situation, the industry is repeating its old error of increasing over-all refinery runs to meet an unprecedented heating oil demand instead of maximizing distillate and minimizing gasoline yields, which could be accomplished with a more moderate increase in refinery runs," he said.

Regarding yields ratio, he said "a five percent shift in favor of distillates would bring supply in much better balance to meet these demands, and would also make economic sense.

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Chemicals Face Tougher Future, Says Esso VP

The chemical industry will "have to become accustomed to the rough roads of reality" rather than the predicted "broad horizons of opportunity" says O. V. Tracy, vice president and director of Esso Standard Oil Co. He cited as factors that will bear on the industry's growth pattern:

- New entries into the chemical business.
- Excess capacity, particularly benzene, methanol, butadiene, ammonia and epoxy resins.
- Impact of foreign competition due to progress in European chemical plant construction. Excess German and Iron Curtain production is finding its way to our markets without difficulty.
- In domestic chemical industry we have "caught up with ourselves."

He said "demand for chemical products in certain areas has already started to level out, and now more nearly parallels the growth of the consumer product. Tracy added that synthetic fibers and plastics still present "considerable opportunity."

Military to Boost Oil Buys During Next 5 Years

The military's petroleum product purchases are expected to rise 131,000 bpd during the fiscal year 1959, according to the Defense Department's Petroleum Logistics division. This will be an average of 739,000 bpd for both domestic and overseas liftings.

The military is seeking to increase inventories after being restricted on purchases under the 1958 budget, the division noted. The fiscal 1958 average was 608,000 bpd, while fiscal 1957 was 670,000. The trend of purchases is: 1961—720,000 bpd, 1962—717,000 bpd, and 1963—713,000 bpd.

New Officers Elected by Industrial Waste Group

The National Technical Task Committee for industrial wastes will continue to direct its attention both to immediate and long range planning on problems related to industrial wages, it was decided at the organization's ninth annual meeting held December 11-12 at Cincinnati. It was attended by 52 scientists and engineers from most of the nation's major industries.

Elected officers for 1959 were: Ray S. Glynn, director of sanitation research and development, Association of American Railroads, chairman; A. J. Steffen, director of sanitary engineering, Research and Technical division, Wilson & Co., Inc., vice chairman; L. S. Warrick,

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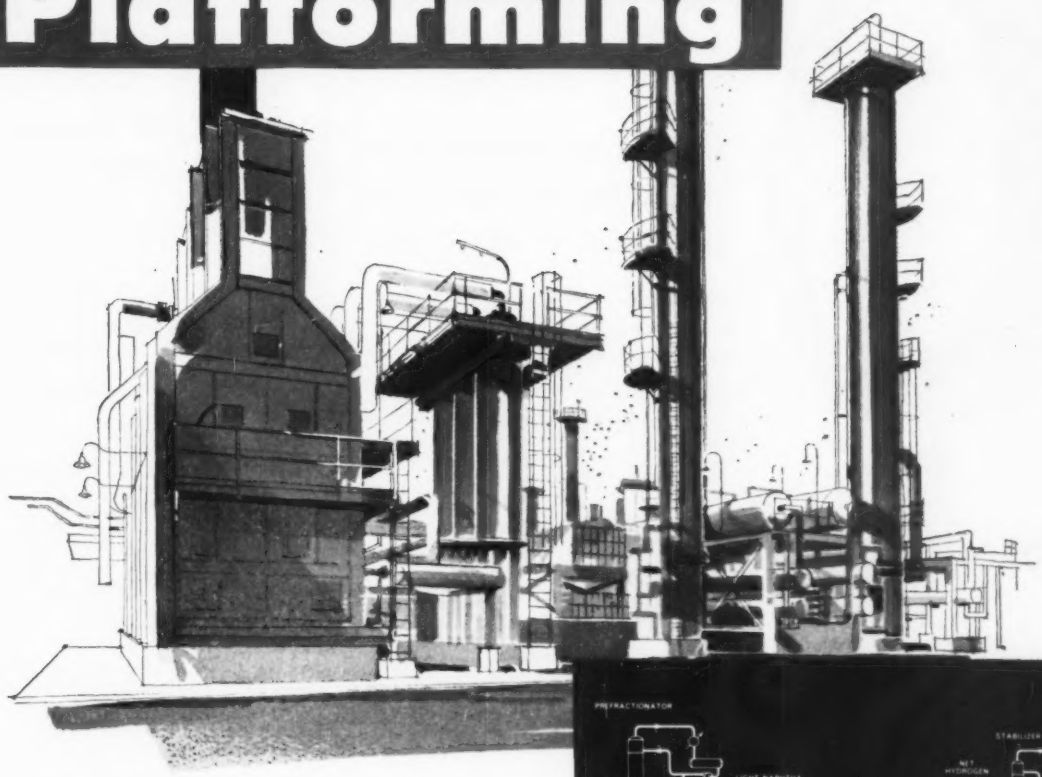

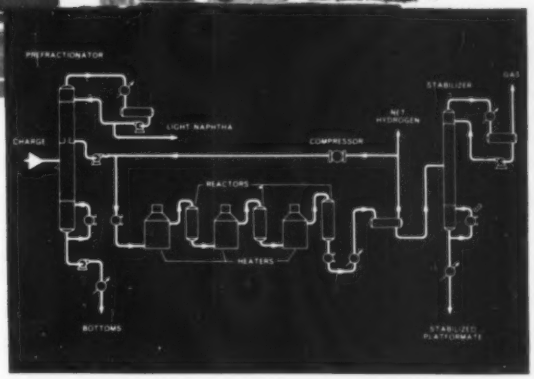

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As shown in the accompanying flow diagram, the Platformer is a compact unit consisting of a reactor section, stabilizer section, and (optional) feed preparation section. It can handle the full boiling range gasolines without prefractionation, or naphtha cuts separated from them, and efficiently processes any naphtha from crude distillation, natural gasoline plants or cracking units.

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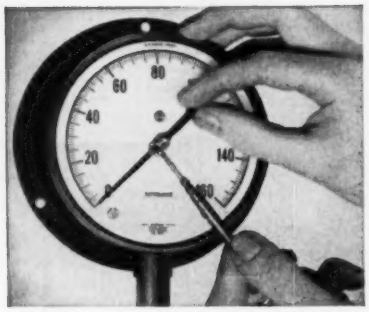
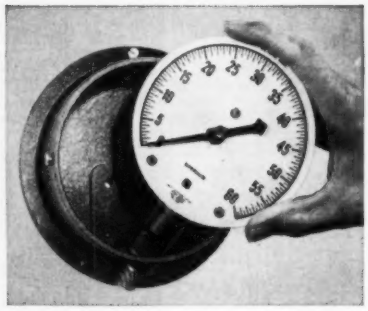
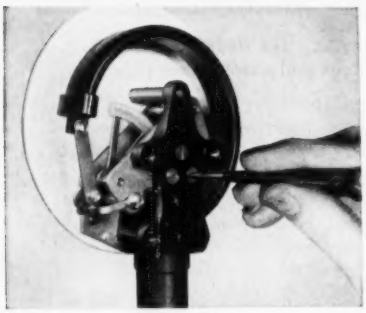


NOTE that with Supergauges, adjustments for "zero shift" can be readily made from the front, with gauge in operating position and without removing pointer from the shaft. Location of positive, self-locking worm adjustment screw on *side* of pointer prevents axial distortion of pointer or bending of shaft during adjustment.



NOTE that with USG Mono-Unit design, all Supergauge internals are integrated into a single assembly which can be removed in one quick operation. Complete legends on laminated plastic dials give gauge model number and materials used in construction of components for instant identification. More maintenance minutes saved!



NOTE that with USG's patented Arc-Loc movement, corrections for "scale shape" (linearity) errors and "range" adjustments are both made from the rear. No time is wasted in having to remove the pointer and dial. Each adjustment is a simple screwdriver operation; no special tools are required. In addition, USG's unique locking method eliminates creep during locking, further speeding recalibration time.

AND NOTE ESPECIALLY...

Supergauges meet ASA specifications for Grade AA Test Gauges, including accuracy within ½ of 1% of scale range. They are available in a full line, embracing a wide selection of case styles (including aluminum), case sizes, pressure ranges and materials of construction.

A companion line of SOLFRUNT (solid front construction) gauges is also available with the same fine USG features.

For complete information on SUPERGAUGE and SOLFRUNT process gauges, contact your local USG Distributor, or write for Catalog 1819.

UNITED STATES GAUGE
DIVISION OF AMERICAN MACHINE AND METALS, INC., SELLERSVILLE, PA.

USG

Happenings

sanitary engineer director, technical services consultant, water supply and water pollution control program, Public Health Service, secretary.

ICWU, OCAW Progress In Plans For Merger

Progress toward merger of the International Chemical Workers Union and the Oil, Chemical & Atomic Workers Union was reported following a meeting in Cleveland of the top four officers in each organization. A joint statement said "we have every confidence that ultimately we will be able to provide our joint merger committee with concrete comprehensive plans for their consideration and debate."

Oil Faces Year of Decision Says IPAA President

The year 1959 will be one of decision for the domestic petroleum industry, according to Gordon Simpson, president of the Independent Petroleum Association. He said the five most serous problems to be faced this year are:

- Continued misunderstanding of the industry, its aims and accomplishments.
- Intensified efforts to disrupt established tax provisions relative to oil and gas through unwarranted and emotional attacks on percentage depletion.
- Unworkable and unnecessary federal utility-type controls being imposed on domestic natural gas producers.
- Unhealthy economic conditions as evidenced by the squeeze between rising costs and declining prices, low allowables in the face of larger shut-in capacity and downtrends in exploration and drilling when more new reserves must be found to meet increasing demands.
- Increased quantities of petroleum imports, particularly finished and unfinished goods, which are taking a larger and larger share of the domestic market.

Quick Thinking Prevents Fire Damage at Amoco Plant

Human alertness and the use of proper safety equipment prevented serious consequences when a flash fire broke out recently at American Oil Co.'s 40,000-bpd El Dorado, Ark., refinery. Refinery Fire Chief W. C. Vernon distinguished himself with quick thinking and prompt action at the refinery's "time of crisis."

The fire started suddenly when crude oil from a thermal cracking unit surge drum was accidentally ignited as it flowed through a water drawoff valve to sewer facilities.

In the face of a fast-developing fire situation, Vernon hurriedly donned an aluminized fire suit. Safeguarded, he moved through the flaming area to close the valve and shut off the flow of crude oil that had been feeding the fire.

Because fires threaten complete de-

For more data on advertised products, use Readers' Service Cards, last page.

HYDROFINING REPLACES ACID TREATMENT

To eliminate pollution of air and effluent water, reduce operating costs, and to produce a sulphur free finished product, a large Gulf Coast refiner recently placed in operation the above pictured 6000 barrel per day HYDROFINING Unit designed to supplant acid treatment in processing close boiling range naphthas.

Feed stock is vaporized and mixed with hydrogen which catalytically reacts with sulphur contained in the feed stock mostly in the form of mercaptans, to form hydrogen sulphide which is further processed to recover elemental sulphur. After HYDROFINING the liquid product is washed with caustic and filtered through charcoal.

HUDSON furnished mechanical design, materials and equipment; and constructed the HYDROFINING Unit and the Fractionating Unit shown at the left of the picture.

The services of the HUDSON organization, with over 25 years experience in process design, mechanical design and construction are available to process industries in any part of the free world.

DESIGNERS AND CONSTRUCTORS OF PROCESS PLANTS FOR THE OIL, GAS, CHEMICAL, AND MINERAL INDUSTRIES

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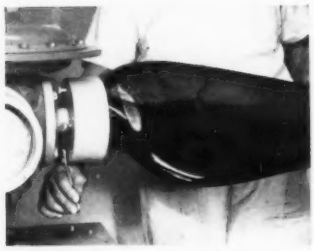
Lightweight.



Easy installation and adjustment.

NEW HUDSON TUF-LITE FANS

After six years of development work and tests of trial field installations operating under wide ranges of conditions in cooling towers, finned tube coolers, and in highly corrosive chemical plant ventilating service, Hudson presents a new product—the TUF-LITE fan. The blades, cast in one seamless piece of fiber glass reinforced synthetic resin, are hollow, light and tough. TUF-LITE fans afford the following advantages over any other available type of fan:

SAFE: TUF-LITE blades being lightweight (about ¼ the weight of other blades with comparable capacity) and infrangible, eliminate the hazards to personnel and equipment existent through accidental throwing or disintegration of heavy metal, wood, or laminated blades while in service.

EFFICIENT: More air is moved at less horsepower because weight and finishing operations do not impose limitations on selections of best aerodynamic design; therefore nearly ideal airfoil cross sections, commercially attainable only in TUF-LITE blades, can be used. Blades will not sag or distort, and surfaces remain permanently smooth.

LOW MAINTENANCE: TUF-LITE blades are unaffected by corrosive, abrasive or impingement effects of hot saturated air, sand, rain, or hail, and have superior deterioration resistance to practically all corrosive vapors or liquids. Blade materials contain color pigment; no painting is necessary. Light weight reduces stress and maintenance on bearings, gears, drive shafts, and supports.

QUIET: The permanently smooth surfaces, very light weight, sustained perfect balance, and advanced aerodynamic design minimize noise.

EASE IN INSTALLATION: Light weight of blades and ingenious design of hub and blade coupling allows attachment of blades by one man using only small wrench. Coupling design assures uniformity of pitch of all blades, and as blades of same size are identical and interchangeable, perfect fan balance is preassured.

In replacement of present fans or in installations on new cooling equipment of any manufacture TAKE ADVANTAGE OF THE OUTSTANDING SUPERIORITY OF HUDSON TUF-LITE FANS.

Bulletin on TUF-LITE FANS
Available upon Request

TUF-LITE protected by U.S. copyrights, patents and patents pending

HUDSON
ENGINEERING CORPORATION

FAIRVIEW STATION • HOUSTON, TEXAS

struction to plant facilities, fire fighting equipment and protective apparel are vital elements of the safety program at the El Dorado refinery. The company says it is impossible to estimate the extent of damage which may have conceivably resulted if Chief Vernon had not acted swiftly, and if the fire suit had not been readily accessible.

Asphalt Imports Revealed By Interior Department

Imports of asphaltic residuum ranged from an average of 48,400 bpd down to 5,800 bpd during the last six months of 1958, according to the Interior Department. Imports of unfinished products averaged 170,000 bpd during the same period. Here is the breakdown for respective months: July, 30,500; August, 48,400; September, 48,400; October, 32,400; November, 30,900 and December, 5,800.

Rumanian Oil Shipment Draws Heavy Criticism

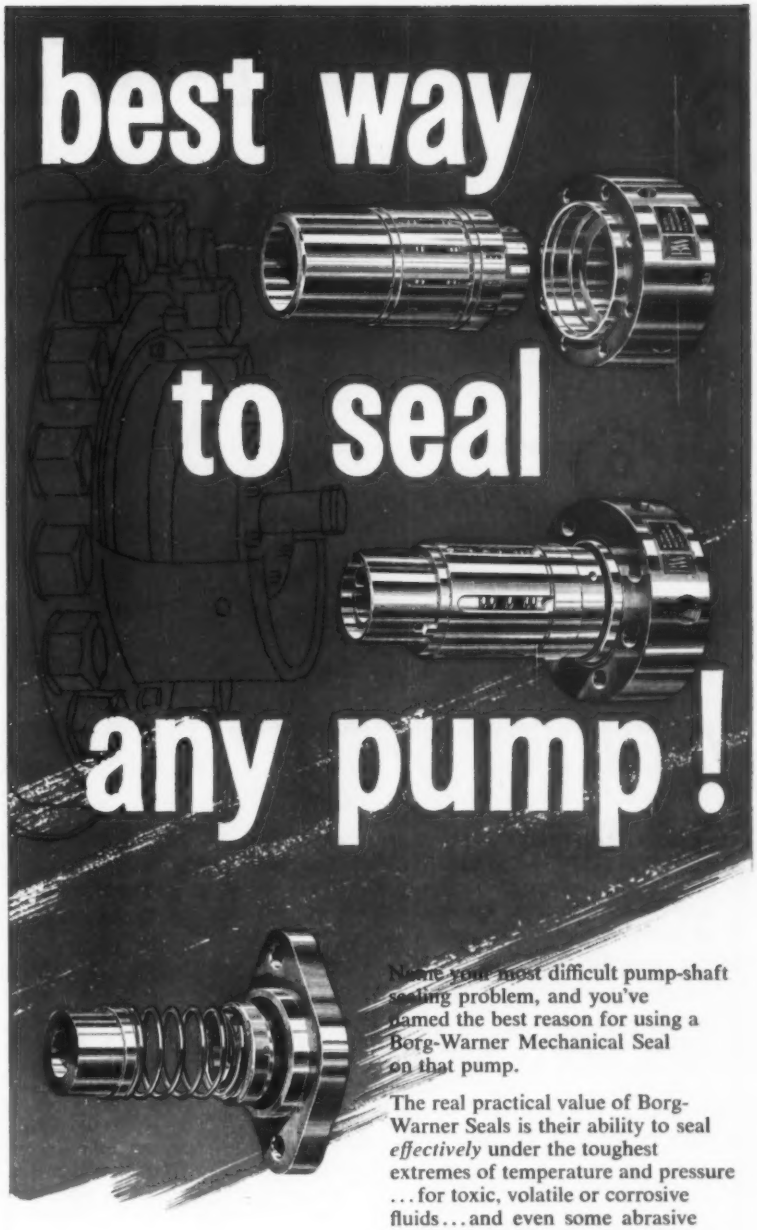
A shipload of Rumanian residual oil destined for the United States is only "the entering wedge of a determined communist drive to dominate the American fuel market and seriously damage the essential American oil and coal industries," warns the National Coal Association. NCA Executive Vice President Tom Pickett said, "the money it brings would not go back to Rumania but would furnish dollars for the use of international communism in its campaign of economic warfare and political subversion around the world."

Criticism of the move continues to mount in Washington. Senators Byrd and Randolph of West Virginia wired President Eisenhower that the Communist oil shipment emphasizes the need for mandatory imports controls. The IPPA charged "government indecision" in formulating a workable new imports control plan.

Teamsters Union Bids to Take in Bayway's IPWU

Teamster President James R. Hoffa has told Bayway, N. J.'s IPWU that the Teamsters Union would be willing to affiliate with it. An IPWU source reported Hoffa's appearance was "impressive" as he spoke before 400 IPWU members in New York. Question of IPWU's possible affiliation with an international union came up when Michael Woytowicz resigned as IPWU president in November, charging union had "outworn its usefulness."

Now Turn the Page and Read Changing Times



Name your most difficult pump-shaft sealing problem, and you've named the best reason for using a Borg-Warner Mechanical Seal on that pump.

The real practical value of Borg-Warner Seals is their ability to seal *effectively* under the toughest extremes of temperature and pressure ... for toxic, volatile or corrosive fluids ... and even some abrasive liquids. *Result*—less down time, elimination of expensive stuffingbox maintenance, and savings of the pumped fluid.

Borg-Warner Mechanical Seals

NOW AVAILABLE—a new file folder of Borg-Warner Mechanical Seal designs shows some of the many types and applications possible for pumps, mixers, autoclaves and for special rotating shaft problems. Send for your copy today—there's no obligation!

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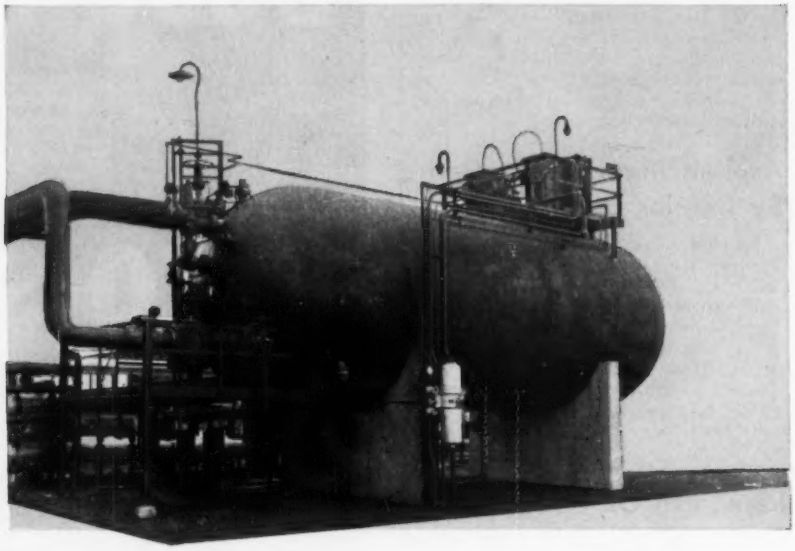
For more data on advertised products, use Readers' Service Cards, last page.

PRODUCT IMPROVEMENT WITH

PETRECO



facts to consider

WHEN YOU SPECIFY DESALTING EQUIPMENT

1 EFFICIENCY IS MEASURED IN TERMS OF REMAINING IMPURITIES. The ultimate measure of any desalting process is its thoroughness in removing salts and impurities—*not how much salt is removed, but how much salt is left in.*

PETRECO* all-electric desalters consistently deliver desalting results with residual impurities in the 0 to 1 ptb range.

2 SALT "SETTLING" IS NOT TRUE DESALTING. Salt settling is one way to remove salts, but desalting is something else. "Settling", using long "residence time" in large volumetric capacity settlers, was one of the first methods ever used to remove salts.

Petreco all-electric desalting is an engineered method for the extraction of salts from crude oil. The mixture of the oil and salt-bearing brine is combined precisely with the correct amount of fresh water, and exposed to the powerful forces of the electric field to achieve fast, efficient separation.

3 TIME, DISTANCE AND SETTLING SPACE ARE NOT IMPORTANT FACTORS IN PETRECO ALL-ELECTRIC DESALTING. These natural developments are vital only to desalting methods wherein settling is necessary to the functioning of the process.

In Petreco all-electric desalting, engineered emulsification, distribution and demulsification bring about rapid, controlled action.

Because of this, Petreco desalters are usually smaller than vessels used in less advanced methods. This means savings in the cost of the vessel required, the amount of piping and the ground area needed—and yet provides a maximum yield in salt removals.

Remember—when you specify your next desalting installation, there is no substitute for Petreco's engineering design.

*PETRECO *is a registered trade mark of Petrolite Corporation.*

DS-59-1

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VENEZUELA: South American Petrolite Corporation, Hotel Avila, Caracas

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COLOMBIA: South American Petrolite Corporation, Calle 19, No. 7-30, Office 807, Bogota
ITALY: O. Wagner, 149 Via Nemorense, Apt. 1, Rome
JAPAN: Chiyoda Chemical Engineering and Construction Company, Ltd., Tokyo Bldg., No. 3, Marunouchi 2-Chome, Chiyoda-Ku, Tokyo
KUWAIT: F. N. Dahdah, Box 1713, Al Kuwait
MEXICO: R. E. Power, Sierra de Mijes, No. 125, Mexico D. F.
NETHERLANDS: F. E. C. Jenkins, Hoefbladlaan 134, The Hague
TRINIDAD: Neal and Massy, Ltd., Port of Spain, P. O. Box 544

Superior Propane, Ltd. has acquired propane business of H. May, Ltd., St. Therese, Quebec. All storage equipment, tanks, and regulating equipment are involved.

A new Australian Co., CSR Dow Pty., Ltd., has been formed to produce styrene. Company is jointly owned by Dow Chemical Co. and C.S.R. Chemicals Pty., Ltd.

Continental Oil Co. has formed Continental Oil Co. (Netherland), N.V., with offices at Coolsingel 57, Rotterdam. Formation of new subsidiary follows closely recent establishment of Foreign department office in New York.

Firth Sterling, Inc., Pittsburgh, has purchased The M. W. Kellogg Co.'s specialty alloy steel manufacturing business. Involved were all patents, inventories and production facilities of Kellogg ingot process.

The Standard Oil Company (Ohio) has formed Distribution and Traffic divisions through separation of two operations in Supply and Distribution department.

Raymond International, Inc., has been awarded two contracts for multi-million dollar construction projects **for oil loading facilities in Gulf of Arabia (Persian Gulf);** one offshore from Iraq and one from Iran. Development involves **$60 million investment.**

Monsanto Chemical Co.'s Lion Oil division established company safety record in 1958. Record involved a new low of 0.31 injuries per million man-hours, and severity rate of 4.39 work-days lost per million man-hours.

Nafco Oil and Gas Co. has agreed to purchase oil and gas properties and other assets of Oil and Gas Property Management, Inc., Dallas. Properties include three gasoline plants owned by Dorchester Corp., subsidiary of OGPM.

Monsanto Chemical Co. is preparing for common market sales, and has concluded partnership arrangement with Societa Edison, Milan, Italy.

ENI, Italy's government oil entity, will import additional Russian fuel oil in exchange for Italian produced machinery for petrochemical industry. Alarming **proposal involves $160-million trade exchange** for 1959.

Price of previously announced **Universal Oil Products Co. stock sale has been set at $72.5 million.** Trustee of company has filed for registration of the 2.9 million shares.

Dry cargo vessel "Methane Pioneer" has landed in England with first transocean delivery of methane. The 32,000-barrel craft is converted dry cargo vessel. Owned by British Methane, Bahamas, formed by Constock International Methane and Gas Council of Great Britain, **company says ship is "first of coming fleet carrying energy in this concentrated form."**

Standard Oil Co. of Calif. says it will spend $400 million in 1959. This is $50 million more than 1958 expenditures. **Refinery expansion** program will absorb **$60 million** of outlay.

Justice Department's Antitrust Division is embarking on investigation of U.S. Steel and General Motors Corporations. This may signal modification of DJ's previous obsession with oil industry. **DJ may feel it has been barking up wrong tree—seek others.**

New safe-driving booklet for teenagers is being distributed as public service by Standard Oil Co. (Ind.) National Safety Council called it **"one of the most important contributions to safety ever made."** Book is available from Indiana Standard dealers in Midwest, Amoco dealers in the South and East, and Utoco dealers in West.

Gulf Italia is suing Italian Communist newspaper *l'Unita* for libel on basis of November 9 article **claiming Gulf's Ragusa, Sicily, discoveries were based on geological studies taken by Allies during war.**

Shell Oil Co. of Canada, Ltd., says it "has been able to reduce, to a very low value, the **probability of failure" of materials due to sulfide corrosion.** Report covers 10-year experience handling sour gas condensate in Western Canada.

- Changing Times -

Sinclair Chemicals, Inc., has changed name to Sinclair Petrochemicals, Inc. Personnel, offices and operations remain unchanged.

California Texas Corp. has changed name to California Texas Oil Corp., and will carry on service functions previously performed by California Texas Oil Co., Ltd.

Canadian Oil Companies, Ltd., the only major fully-integrated oil company owned and operated by Canadians, **recently celebrated its 50th anniversary.**

Gulf Oil Corp. has exercised option to increase its financial interest in Caller Chemical Co. to 50 percent. Option was part of original purchase agreement.

Famous **WORKLON** acid-resistant

INDUSTRIAL APPAREL

now "Astonized" to

END STATIC HAZARDS FOREVER!

100% Dynel fabric by **Chrysler Textiles, Inc.**

"Astonized" static-free finish by **Onyx Oil & Chemical Co.**

Perfected at last – the first effective solution to the static hazard in your plant or laboratory! New Worklon industrial apparel of 100% Union Carbide Dynel is both **acid-resistant** and **STATIC-FREE**... proved less static than cotton... and **remaining static-free for the life of the garment!**

- **Resists damage** from acids and caustics up to 50 times longer than ordinary garments!
- **More comfortable!** Will not cling. No clammy feel.
- **Far safer!** No flash burning of fabric.

FREE

Learn the facts about this exclusive Worklon development. Mail coupon for latest 1959 catalog plus data sheet on new static-free Dynel industrial apparel. No cost, no obligation, of course!

WORKLON

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Kindly send free Worklon catalog and static-free data sheet.

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For best-balanced lining durability –

A famous family of

H-W CASTABLES AND OTHER MONOLITHIC REFRACTORIES

H-W REFRACTORY BRICK AND SHAPES

H-W INSULATING REFRACTORIES

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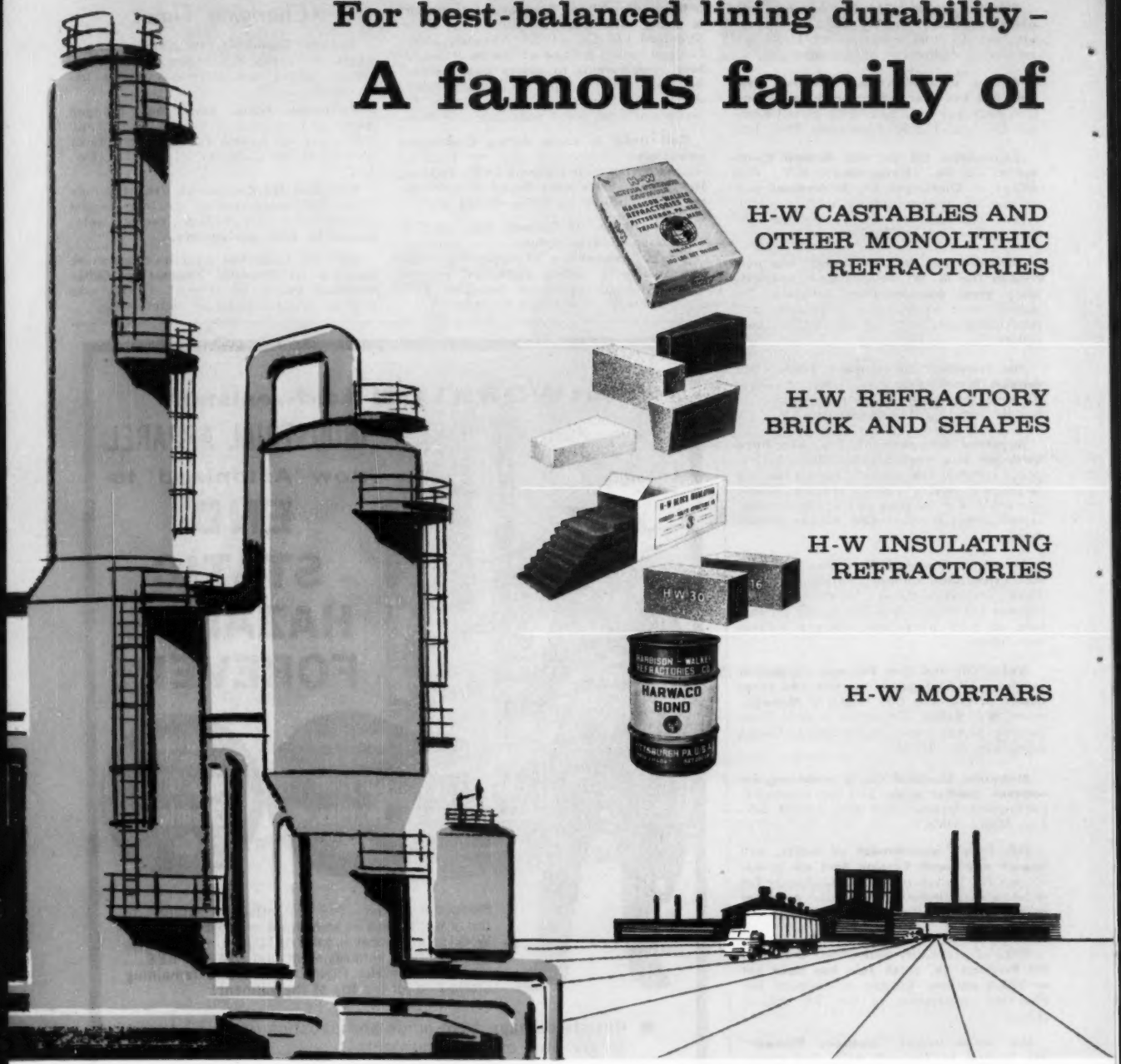


For maximum resistance to corrosion . . .

chemical reactions . . . reducing atmospheres...

over all temperature ranges

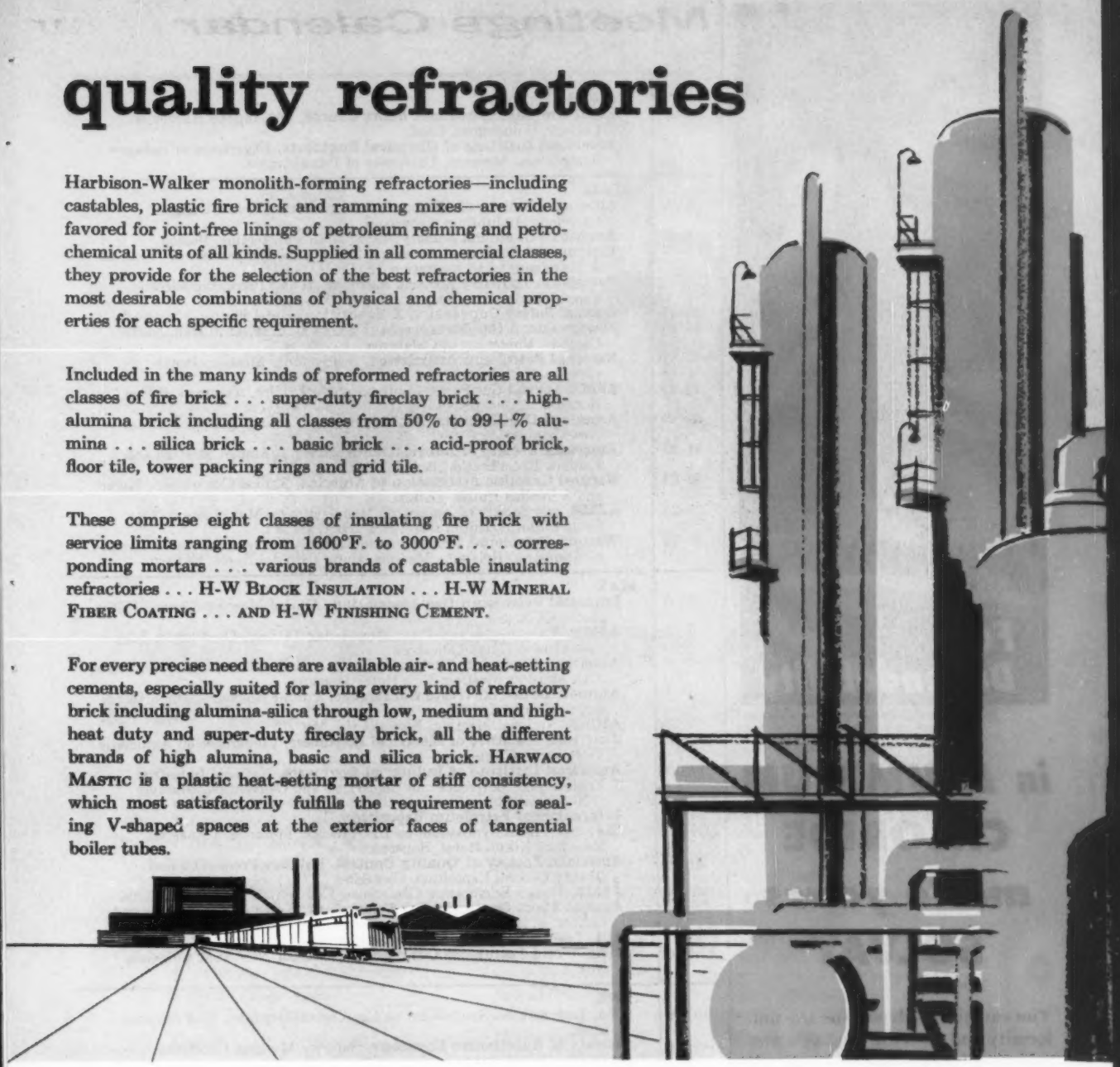
quality refractories

Harbison-Walker monolith-forming refractories—including castables, plastic fire brick and ramming mixes—are widely favored for joint-free linings of petroleum refining and petro-chemical units of all kinds. Supplied in all commercial classes, they provide for the selection of the best refractories in the most desirable combinations of physical and chemical properties for each specific requirement.

Included in the many kinds of preformed refractories are all classes of fire brick . . . super-duty fireclay brick . . . high-alumina brick including all classes from 50% to 99+% alumina . . . silica brick . . . basic brick . . . acid-proof brick, floor tile, tower packing rings and grid tile.

These comprise eight classes of insulating fire brick with service limits ranging from 1600°F. to 3000°F. . . . corresponding mortars . . . various brands of castable insulating refractories . . . H-W BLOCK INSULATION . . . H-W MINERAL FIBER COATING . . . AND H-W FINISHING CEMENT.

For every precise need there are available air- and heat-setting cements, especially suited for laying every kind of refractory brick including alumina-silica through low, medium and high-heat duty and super-duty fireclay brick, all the different brands of high alumina, basic and silica brick. HARWACO MASTIC is a plastic heat-setting mortar of stiff consistency, which most satisfactorily fulfills the requirement for sealing V-shaped spaces at the exterior faces of tangential boiler tubes.



Harbison-Walker produces all the types and classes of refractories needed to meet the highly-specialized requirements of today's refinery and petro-chemical processing operations. Properly selected, they assure maximum corrosion resistance to various sulphur compounds and hydrocarbons . . . withstand severe fluxing effect of oil ash and resist abrasion, erosion and disintegrating actions of reducing atmospheres through critical temperature ranges.

The Harbison-Walker Technical Service Department freely offers assistance in the selection and use of the refractories that will best serve your particular application with greatest overall economy. Nearby manufacturing plants and warehouses help you realize added economies in transportation time and cost.

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One of the world's most dependable performers—"Old Faithful" Geyser.

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Meetings Calendar

MARCH

26–27 **Eight Annual Instrument Short Course,** Los Angeles Harbor Jr. College, Wilmington, Calif.

31 **American Institute of Chemical Engineers,** Experience in Industry Symposium, Museum, University of Pennsylvania.

APRIL

5–10 **American Society of Mechanical Engineers,** Nuclear Congress, Cleveland Auditorium, Cleveland.

5–10 **American Chemical Society,** 135th National Meeting, Boston.

6– 7 **Instrument Society of America,** 2nd Annual Symposium on Chemical & Petroleum Instrumentation, St. Louis.

7– 9 **Petroleum Industry Electric Association** and Petroleum Electric Supply Association Meeting, Moody Center, Galveston.

13–17 **Annual Safety Convention X Exposition,** Hotel Statler, New York.

14–16 **Southwestern Gas Measurement Short Course,** Drill Hall, North Campus, University of Oklahoma.

15–17 **National Petroleum Association,** Semi-annual Meeting, Hotel Cleveland, Cleveland.

19–23 **ASME,** Oil and Gas Power Conference and Exhibit, Shamrock Hilton, Houston.

20–22 **American Oil Chemists' Society,** Spring Meeting, Roosevelt Hotel, New Orleans.

21–23 **American Society of Lubrication Engineers,** Annual Meeting and Exhibit, Hotel Statler, Buffalo, N.Y.

22–24 **Natural Gasoline Association of America,** Annual Convention, Baker and Adolphus Hotels, Dallas.

23–24 **ASME,** and Society of Apparatus Manufacturers, Management Conference, Statler-Hilton Hotel New York.

29–30 **Western Petroleum Refiners Association,** Southwest Regional Technical-Industrial Relations Meeting, Hotel Paso del Norte, El Paso.

MAY

3– 6 **Liquefied Petroleum Gas Association,** Annual Meeting, Conrad Hilton Hotel, Chicago.

4– 5 **ASME,** Maintenance and Plant Engineering Division Conference, Edgewater Beach Hotel, Chicago.

4– 8 **American Petroleum Institute,** Safety and Fire Protection Committees, 12th Midyear Meeting, Rice Hotel, Houston.

5– 7 **Annual Industrial Waste Conference,** Purdue Memorial Union Building, Lafayette, Ind.

10–13 **AIChE,** National Meeting, Kansas City, Mo.

11–13 **American Institute of Electrical Engineers,** Conference on Automatic Techniques, Chicago.

14–16 **American Institute of Industrial Engineers,** National Industrial Engineering Conference and Conference and Convention, Biltmore Hotel, Atlanta.

14–23 **International Petroleum Exposition,** Tulsa.

18–20 **ISA,** 5th Annual Symposium on Instrumental Methods of Analysis, Shamrock Hilton Hotel, Houston.

25–27 **American Society of Quality Control,** Industry Production and Quality Control Exposition, Cleveland.

25–28 **ASME,** Design Engineering Conference, Convention Hall, Philadelphia.

27–29 **Annual Short Course in Gas Technology,** Texas College of Arts and Industries, Kingsville, Texas.

27–30 **API,** Division of Refining, Midyear Meeting, New York.

30–Jun 5 **Fifth World Petroleum Congress Exposition,** New York Coliseum, New York.

JUNE

10–12 **ISA,** International Symposium on Gas Chromatography, East Lansing, Mich.

14–19 **Society of Automotive Engineers,** Summer Meeting, Chalfonte-Haddon Hotel, Atlantic, City.

17–18 **ASME,** Engineering Management Conference, Statler Hilton Hotel, Los Angeles.

21–26 **American Society for Testing Materials,** Annual Meeting Chalfonte-Hadden Hall, Atlantic City.

24–25 **WPRA,** Mid-Continent Technical-Industrial Relations Meeting, Broadview Hotel, Wichita.

AUGUST

10–13 **Society of Automotive Engineers,** National West Coast Meeting, Hotel Georgia, Vancouver, B.C.

SEPTEMBER

9–10 **ASME,** International Congress on Air Pollution, New York.

13–18 **ACS,** 136th National Meeting, Atlantic, City.

17– **NGAA,** Rocky Mountain Regional Meeting, Casper or Calgary, Alberta.

20–23 **ASME,** Petroleum Mechanical Engineering Conference, Rice Hotel, Houston.

21–25 **ISA,** Annual Instrumentation-Automation Conference and Exhibit. International Amphitheater, Chicago.

"YOU CAN BE REPLACED But Our P.F.I. Standards Can't"

1 Machining Backing Rings for Butt Welds
2 Dimensioning Welded Assemblies
3 Linear Tolerances Bending Radii
4 Shop Hydrostatic Testing
5 Cleaning Fabricated Piping
6 Built-up Weld, Metal Bosses
7 Welded Nozzles—Spacing
8 Preheat-Postheat Before, After Welding
9 Arc-Welding Dissimilar Ferritic Steels
10 Stress Relieving Practices

Sure it's aggravating not to find what you are looking for . . . when you need it.

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While these Standards are packed with vital data on the design, fabrication and erection of industrial and high pressure—high temperature piping, they do not explain the many advantages of shop fabrication.

Shop fabrication by firms responsible for the development of P.F.I. Standards is your only real assurance of meeting the most exacting requirements of piping, whether it's welded, bent, coiled or vanstoned . . . in any metal as a component or a complete assembly.

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For more data on advertised products, use Readers' Service Cards, last page.

Men In Industry...

Rader

Knight

Ralph M. Knight has been named manager of polyolefin planning and applications for U. S. Industrial Chemicals Co. He will be responsible for long-range planning and coordination of U.S.I.'s polymer development program, and will also direct the company's Polymer Service laboratories, Tuscola, Ill.

William H. Rader has been named polyethylene production manager. He joined U.S.I.'s parent company in 1953. Before his promotion he was assistant polyethylene production manager.

Henry A. Heiss, manager of the Destrehan refinery of the American Oil Co., has been named manager of the Amoco refinery at El Dorado, Ark. A native of Pueblo, Colo., he joined Standard Oil Co. (Ind.), as a chemical engineer at the Whiting refinery in 1937. A series of promotions led to his transfer to Destrehan as refinery manager in 1951. Heiss received a B.S. degree from the University of Iowa in 1932.

Heiss

C. Arthur Miller has been elected president of the American Association of Cost Engineers. Other officers are: vice president, **Bernard J. Gaffney,** Wood Conversion Co., St. Paul, Minn.; treasurer, **Cecil H. Chilton,** McGraw-Hill Publishing Co., N. Y., and secretary, **E. F. Brummerstedt,** The Foster Wheeler Corp., N. Y. A mechanical engineering graduate from the University of Toronto, Miller is supervisor of cost studies, scheduling and standards in the Engineering department, Canadian Industries, Ltd.

Charles W. Smith has been named chief staff engineer, Esso Research and Engineering Co. He was previously director of the Employee Relations division.

Dr. G. A. Schurman has been named manager of producing research by the La Habra laboratory of California Research Corp. Since joining the La Habra staff in 1950, he has held a number of research and staff positions.

John F. Kunc has been appointed senior research associate, Esso Research and Engineering Co. With the Products Research division, he is in charge of the division's long-range research work on fuels.

The Union resident, an Esso Research veteran with 32 years' service, began his company career as a messenger. He earned a B.S. degree in chemistry at Brooklyn Polytechnic Institute in 1934.

Mr. Kunc is a member of the American Chemical Society and the Nuclear Engineering division of the American Institute of Chemical Engineers and the Atomic and Industrial Forum. He also is active in the coordinating research council, jointly sponsored by the American Petroleum Institute and the Society of Automotive Engineers, and vice president of the latter organization.

John E. Walkey has been named manager, process development, by The California Oil Co. He joined Caloil in 1957 after 12 years with California Research Corp., where he was with the Process and Plant Design division.

E. D. Hillback has been named assistant vice president of The California Oil Co.'s Lubricants division. Assistant to the president since 1955, he joined StanCal as a credit clerk in 1941.

Frank J. MacRae has been named manager of Plastics Technical Service, The Dow Chemical Co. He joined Dow in 1941 as an engineer of the Dow Magnesium Corp.

Clifford E. Oman has been appointed Tuscola, Ill., general manager for U. S. Industrial Chemicals Co. He will be responsible for operations at the company's petrochemical plant there. In 1951, he joined National Distillers and Chemical Corp. as an area superintendent, and was assistant plant manager at the time of his new appointment. He holds a B.S. degree in chemical engineering from the University of Minnesota, and was previously employed by Elgin Softner Corporation, Atlas Powder Company, and Shell Oil Company. He is a member of the American Institute of Chemical Engineers.

Oman

John M. Brown has been named refinery manager of Lake Superior Refining Co. A native Arkansan, he has had 34 years experience in refining. He joined American Oil Co. in 1925 as a stillman —advanced to assistant manager in 1955, and in 1956 became manager of the El Dorado refinery.

Lon C. Hill and George G. Matkin have been elected to the board of directors, Delhi-Taylor Oil Corp. Hill is chairman of the board and past president of Central Power and Light Co., Corpus Christi, Texas. Matkin is president of the State National Bank, El Paso, Texas.

John J. Scott, general counsel of Socony Mobil Oil Co., N. Y., and **William G. King, Jr.,** vice president of marketing, Richfield Oil Corp., Los Angeles, have been appointed to the committee on public affairs of API.

Dr. Maurice L. Huggins, a specialist in high-polymer chemistry research, has joined the Physical Science division of Stanford Research Institute as manager of the Physical Chemistry section. He was previously with the Research laboratories, Eastman Kodak Co.

Samuel W. Harris has been named manager of the Wynnewood, Okla., refinery of Kerr-McGee Oil Industries, Inc., and **Bernard A. Paulson** has been named manager of the Cleveland refinery.

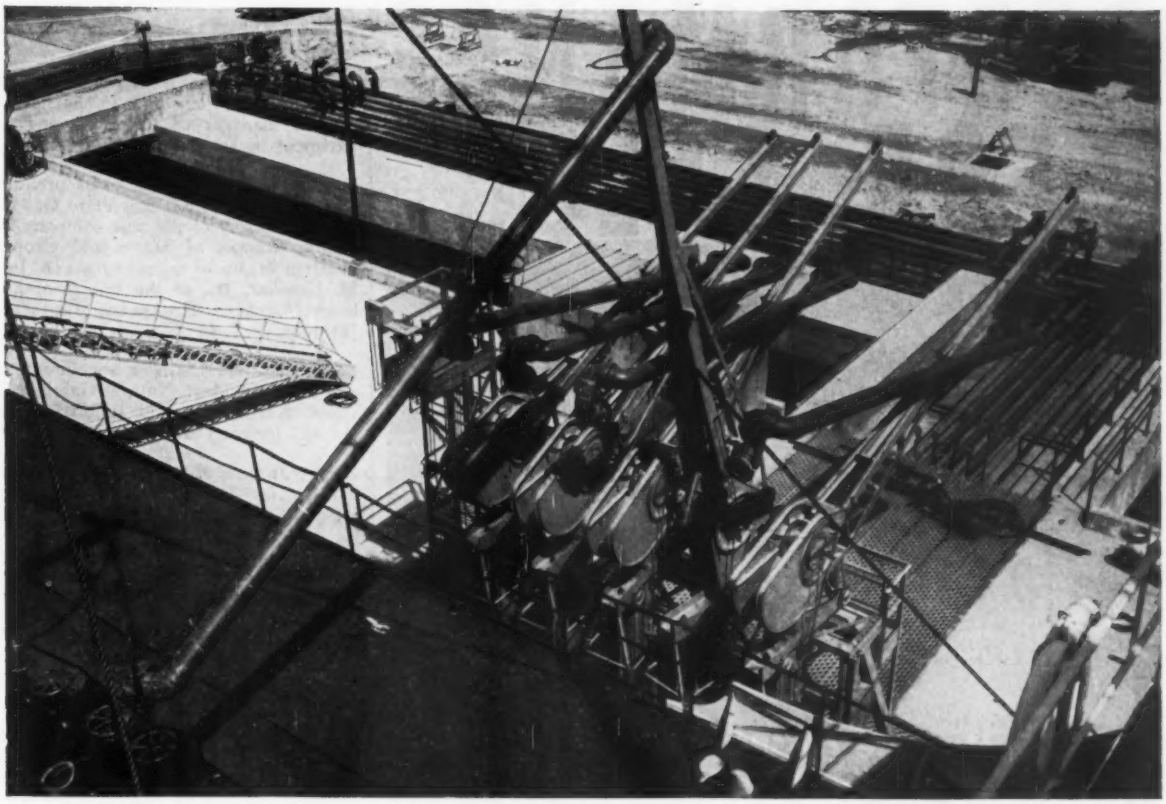
Dr. Cosimo Torre has been named research associate by The M. W. Kellogg Co. Formerly a research professor at Syracuse University, he will engage in mechanical development.

Dr.'s Leo J. O'Brien and Melvin A. Rosenfeld have been named directors of newly created divisions at The Pure Oil Co.'s Research center. Dr. O'Brien joined Pure in 1940 and Dr. Rosenfeld in 1957.

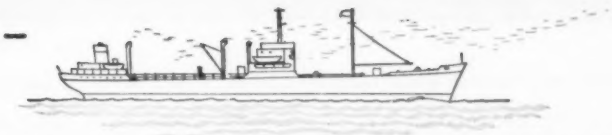
Jerry A. Cogan, vice president and director of Imperial Oil Co., Ltd., has been elected to the board of directors of Esso Research and Engineering Co. He was formerly head of Standard Oil Co. (N. J.) Coordination and Petroleum Economics department.

Fred H. Moore has been named executive vice president of Magnolia Petroleum Co. and elected to its board of directors. He has been general manager of producing operations of Socony Mobil Oil Co., Inc., for the past 14 months. Moore received his B.S. degree in geology from Texas Technological College in 1930, and his M.S. degree in geology from the University of Virginia in 1931. In 1935 he joined Magnolia as a field geol-

Moore



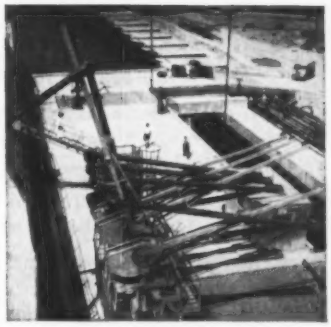
IN SHIPPING—



CHIKSAN MARINE LOADING ARMS

GIVE A MODERN DAY LIFT TO TANKER LOADING!

Hooking up hose lines to a tanker is often a rough, dirty, and sometimes dangerous task. However, loading drudgery is becoming just a memory wherever the new Chiksan Marine Loading Arm has gone into service. Heralded by many as the first basic improvement in the loading of marine tankers in over 30 years, the new Chiksan Loading Arm not only insures faster tanker turn-around time, but promises material savings of lost man-hours due to hose handling injuries, insurance and compensation premiums, and expensive rubber hose replacements. Savings within a decade, one customer estimates, will actually amount to the purchase price of a 5-arm unit. For descriptive literature, write Chiksan, Brea, California.



Where once a crew of seven men labored for 30 minutes to hook up a rubber line, now one man operating hydraulic controls can swing a Chiksan Loading Arm aboard, for hook up, in less than a minute.

A SUBSIDIARY OF FOOD MACHINERY AND CHEMICAL CORPORATION

fmc CHIKSAN

CHIKSAN COMPANY—BREA, CALIFORNIA • CHICAGO 5, ILLINOIS • NEWARK 2, NEW JERSEY

Well Equipment Mfg. Corp. (Division), Houston 1, Texas • Subsidiaries: Chiksan Export Company • Chiksan of Canada Ltd.

For more data on advertised products, use Readers' Service Cards, last page.

PERFORMANCE FOR SALE!

with Hartzite Plastic Adjustable Pitch Cooling Tower and Heat Exchanger Fans

Good performance costs nothing extra ... yet saves so much.

This statement sums up the performance and economy of Hartzell Adjustable Pitch fans made from Hartzite plastic.

Since its introduction in 1941, Hartzite plastic has practically eliminated fan blade replacement problems while providing high efficiency operation.

Hartzite blades have been job-proven on thousands of installations to effectively resist corrosion, abrasion and vibration. Increased strength and efficiency are achieved by use of a tapered blade and a heavily reinforced leading edge.

Welded steel hubs are dynamically balanced and each blade is balanced to a master blade. Gussets provide extra strength and increased safety.

Hartzite fans are available in 10′ to 22′ sizes. Hubs are designed for 2, 3, 4 or 6 blade assemblies.

Again . . . good performance costs nothing extra . . . yet saves so much. Write for all the facts on how Hartzell fans can cut maintenance costs and provide economical, high efficiency operation.

Other famous Hartzell products include controllable and full feathering propellers for light aircraft, crop drying equipment, and farm ventilating fans.

HARTZELL PROPELLER FAN CO.

Engineering Offices in Principal Cities

Div. of Castle Hills Corp. Piqua, Ohio

Men

ogist in Oklahoma. After holding several positions with the company, he became general manager of the Producing department in December, 1957.

Forrest S. Warren is to be president and director of the Texas Petro Gas Co. Other directors of the new company are **Henry Groppe,** of Mares and Groppe, Houston chemical consultants, and **John H. Crooker, Jr.,** of the law firm, Fulbright, Crooker, Freeman, Bates and Jaworski.

C. E. Gessner has been appointed general superintendent, Natural Gasoline division, Kerr-McGee Oil Industries, Inc. He was formerly staff assistant engineer.

Capt. Josiah Hutton, a Sun Oil Co. mariner for 32 years, has been named assistant manager, Marine department. He has been with the company since 1927.

V. H. Ludwig has been named vice president in charge of organization planning and employee relations for Gulf Oil Corp. He joined the company in 1920, and since 1947 has been director of the Employee Relations department.

Howard Sides has been elected assistant secretary and assistant comptroller of Texas Butadiene & Chemical Corp., Houston. With the company since 1956, he has a B.B.A. degree from Southwestern University and a M.B.A. degree from the University of Houston.

Robert M. Thomas has been appointed senior research associate, Esso Research and Engineering Co. He has been assistant director of the Chemicals Research division since 1955.

William P. Gee has been named vice president in charge of petrochemicals for The Texas Co. Formerly president of Texas-U. S. Chemical Co., Gee was educated at the University of Texas and M.I.T.

Charles B. Barry has formed a consulting engineering firm, Barry and Richardson, Dallas, along with J. A. Richardson. The new firm specializes in process and evaluation for the petroleum, natural gas and chemical industries.

Barry has operated as a consultant since 1956 in the U. S. and Canada. Previously, he held engineering positions with various companies for 17 years.

Richardson was with Seaboard Oil Co., Dallas, for seven years as gas engineer and assistant manager of the Gas department. Prior to that he was senior job engineer with Bechtel Corp.

Albert Lawrence Green, Jr., 42, comptroller of Petroleum Chemicals, Inc., died January 9, following a stroke suffered on a hunting trip. A U.S. Marine Corps veteran, he attended Loyola University of Chicago; Carleton College and

For more data on advertised products, use Readers' Service Cards, last page.

to all NATURAL GASOLINE MEN

GREETINGS

from the

NATURAL GASOLINE SUPPLY MEN'S ASSOCIATION

We are looking forward to seeing you at the
THIRTY-EIGHTH ANNUAL CONVENTION
of the NATURAL GASOLINE ASSOCIATION of AMERICA
APRIL 22-24, 1959, BAKER and ADOLPHUS HOTELS
DALLAS, TEXAS

Members of the Natural Gasoline Supply Men's Association

The Aber Company
Airetool Mfg. Co.
Air Products, Inc.
Alco Products, Inc.
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Aluminum Company of America
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Betz Laboratories, Inc.
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Burgess-Manning Co.
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Byron Jackson Pumps, Inc.

Cameron Iron Works, Inc.
Candoo Construction Co., Inc.
Carson Machine & Supply Co.
John H. Carter Company
Chemical Service, Inc.
Chicago Bridge & Iron Co.
Clark Bros. Co., Inc.
Clowe & Cowan, Inc.
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Continental-Emsco Company
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The Cooper-Bessemer Corp.
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Daniel Orifice Fitting Co.
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E. I. duPont deNemours & Co., Inc.

The Eads Company
Allan Edwards, Inc.
Eggelhof Engineers
Elliott Company
Elsey Corporation
Engine Life Products Corp.
Engineering Equipment Co.
Engineers & Fabricators, Inc.
Ethyl Corporation

Farnsworth & Chambers Co., Inc.
Farris Engineering Corporation
The Fish Engineering Corp.
The Fisher Governor Company
Flint Steel Corporation
Flow Measurement Co.
The Fluor Corporation, Ltd.
Fluor Products Company
The Foxboro Company
France Packing Company
Fuller-Austin Insulation Company

Gardner-Denver Company
The Garlock Packing Company
Gas Equipment Co., Inc.
Gasoline Plant Construction Corp.
General American Transportation Corp.
General Electric Company
Fritz W. Glitsch & Sons, Inc.
Goulds Pumps, Inc.
Graver Tank & Mfg. Co., Inc.
The Griscom-Russell Co.
Grove Valve & Regulator Co.

D. W. Haering and Co., Inc.
Hammel-Dahl Div.—General Controls Co.
The Happy Company
Hubbard Electric Company
T. F. Hudgins & Associates, Inc.
Hudson Engineering Corp.

Industrial Scientific, Inc.
Ingersoll-Rand Company
Insulation & Specialties, Inc.

Jones & Laughlin—Supply Div.
Joy Manufacturing Co.

The Koch Engineering Co., Inc.
James S. Kone & Company

Ladish Company
Max E. Landry, Inc.
Warner Lewis Company
A. M. Lockett & Co., Ltd.
The Lubricosos Specialties Mfg. Co.
The Lunkenheimer Company
J. A. Lupfer Company

Maintenance Engineering Corp.
Manning, Maxwell & Moore
Manzel, Inc.
Market Development Div.—Phillips Petroleum Co.
The Marley Company
The Marsh Company
Marsh Instrument & Valve Co.
The William H. Mason Co.
C. A. Mathey Machine Works
McCord Corporation
Lynn McGuffy Company
J. R. Meek Company
Mid-Continent Supply Co.
Minneapolis-Honeywell Regulator Co.
Moorlane Company
Moran Furnace & Sheet Metal Co.
The Mott Company

National Aluminate Corp.
National Supply Co.
National Tank Company
Naylor Pipe Company
Nickles Machine Corporation
Nitrogen Division Allied Chemical Corp.
Nordstrom Valve Div., Rockwell Mfg. Co.
Wm. W. Nugent & Co., Inc.
Nutter Engineering Co.

The Ohio Injector Co.
The Oil Daily
The Oil & Gas Journal
Oil Well Supply Div.—U. S. Steel Corp.
Olin Mathieson Chemical Corp.
O. L. Olsen Company
Orbit Valve Company

Pacific Pumps, Inc.
Paramount Supply Company
Peerless Mfg. Co.
Perry Equipment Corp.
Petro-Chem Development Co., Inc.
Petrocon Engineering Co.
The Petroleum Engineer
Petroleum Refiner
Petroleum Week
Phelps Dodge Copper Products Corp.
Pierce Construction Co.
Pittsburgh Div.—Rockwell Mfg. Co.
Plastelite Engineering Co.
Plibrico Company
Podbielniak, Inc.
Pona Engineers, Inc.
Power Machinery Co.
Power Specialty Co.

J. F. Pritchard & Co.
Process Equipment Co.
Procon, Inc.
Puffer-Sweiven, Inc.

Edward G. Ragatz Company
Rawson-Houlihan Co., Inc.
The Refinery Supply Company
Riddle and Hubbell
Robinson Orifice Fitting Co.
Rockwood Sprinkler Company
Rogers Steel Corp.
Russell Engineering Corp.

E. W. Saybolt & Company
A. O. Smith Corporation
Smithco Engineering, Inc.
Snyder Company, Inc.
Southern Engine & Pump Co.
Southern Petroleum Laboratories
Southwest Industries, Inc.
N. C. Stearns Company
Stearns-Roger Mfg. Co.
Stitt Ignition Company
Stockham Valves & Fittings
Superior Mfg. Co.

Taylor Forge & Pipe Works
Taylor Instrument Companies
Tellepsen Petro-Chem Constructors
The Tennant Co.
Termomeccanica Italiana, Societa per Azioni
Thurmond-McGlothlin
Trinity Steel Company, Inc.
Tube Turns Div.—National Cylinder Gas Co.
Tuloma Builders, Inc.

Union Steam Pump Sales Co.
United Centrifugal Pumps
United Chemical Corporation of New Mexico
Universal Oil Products Co.

Vinson Supply Company
Vulcan Steel Tank Corp.

Walco Engineering & Constr. Co
Westcott & Greis, Inc.
Western Chemical Co., of K. C., Mo.
Western Chemical & Supply Co.
Western Supply Company
The Wickes Boiler Co.
Wilson Supply Co.
Wolverine Tube Division
World Petroleum
Worthington Corporation
Wright Chemical Corporation
Wyatt Metal & Boiler Works

John Zink Burner Company

For more data on advertised products, use Readers' Service Cards, last page.

For the newest ideas in
AIRETROL
AIRETROL

tube maintenance tools

see the big 28 page

AIRETOOL

section in the new refinery catalog

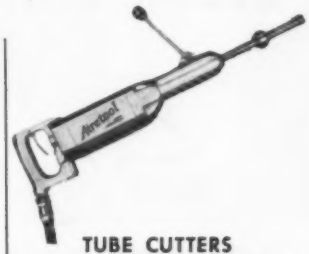
The best way to get tubular maintenance costs down to rock bottom is to use Airetool equipment. This is no idle boast. For over a quarter century, Airetool has pioneered many of the significant improvements in tube maintenance tools. Thus, you can depend on Airetool equipment for the latest developments that assure efficient operation, save you time and money. Order direct from the Refinery Catalog, or call in your nearby Airetool representative.

TUBE CLEANERS

A complete line of air motors and cleaning heads for straight and curved tubes, ½" to 24" I.D.

CONDENSER TUBE CLEANERS

New model CC-475 is easily operated by one man, yet cuts hours off tube cleaning time.

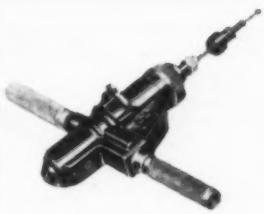


TUBE CUTTERS

Powerful air motor and precision cutting tools speed removal of all types of heat exchanger tubes.

TUBE EXPANDERS

Self-feeding, parallel-rolling expanding tools for every tube size and sheet thickness.



PNEUMATIC EXPANSION CONTROL

Automatically rolls ¼" to 1½" O.D. tubes to uniform accuracy. One man averages 12 tubes per minute easily.

ELECTRIC EXPANSION CONTROLS

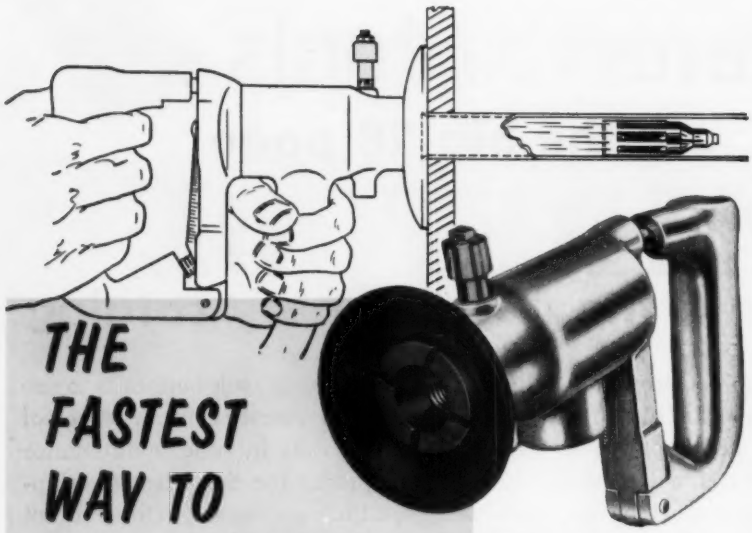
Rolls tubes to maximum tightness automatically, eliminates guesswork, steps up production.

PLANTS:
Airetool Manufacturing Co., Springfield, Ohio; Airetool Nederland, N.V., Vlaardingen, The Netherlands; Airetool Canada, Ltd., Brantford, Ontario

BRANCH OFFICES:
New York, Chicago, Tulsa, Philadelphia, Houston, Baton Rouge

REPRESENTATIVES:
Principal cities of U.S.A., Canada, Mexico, South America, England, Europe, Puerto Rico, Italy, Japan, Hawaii

AIRETOOL
MANUFACTURING COMPANY
SPRINGFIELD, OHIO



THE FASTEST WAY TO CLEAN CONDENSER TUBES

John Crane Super-Jet®

CONDENSER TUBE CLEANER

"John Crane" Super-Jet tube cleaning equipment offers the simplest yet most effective method for maintaining top heat transfer efficiency in steam condensers for these 5 reasons:

1. **EFFICIENT**—handy gun-and-slug method removes slime or scale in record time.
2. **VERSATILE**—interchangeable nozzles permit water or air operation. Slugs are available in types and sizes to insure positive cleaning under practically all conditions.
3. **SPEEDY**—one man can load an entire bank with cleaning slugs and shoot them through in rapid succession.
4. **ECONOMICAL**—slugs can be used over and over again. Rugged gun is built for long, hard service.
5. **EASY OPERATION**—simple-to-operate gun weighs only 2¾ lbs., does not require a skilled worker and can be used for lengthy periods without fatigue.

Request Bulletin P-324. Ask about special 10-day free trial offer.

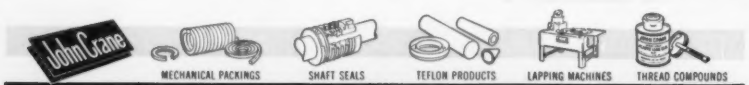
Crane Packing Co., 6420 Oakton Street, Morton Grove, Illinois (Chicago Suburb). *In Canada: Crane Packing Co., Ltd., Hamilton, Ont.*

Interchangeable Nozzles

Air or water operation—effective pressures 50-200 psi.

Slugs For All Services

Spool-type for normal slime removal, bullet-shaped for heavy or thick slime deposits and scraper-type for scale and mineral deposits. Latter two slugs have "jet action" holes that air or water-flush away deposits as removed.



CRANE PACKING COMPANY

Men

Walton School of Commerce, Chicago.

Formerly with Standard Oil Co. (Ind.) and the accounting firm of Barton, Pilie, Hughes and Jones, Green was named comptroller of Petroleum Chemicals in March 1957.

Bernard L. Majewski, president of Great American Oil Co., Chicago, has been elected to the board of directors of Universal Oil Products Co. He recently completed 20 years as a member of the Chicago Board of Education, is a director of the American Petroleum Institute and a director of the Independent Petroleum Association of America. He has been associated with the oil industry since 1909. He also is president of Signal Perfect Fuels, Inc., and a director of Crescent Corp.

Majewski

Alfred H. Gerber has been named chief estimator of The H. K. Ferguson Co. He will supervise the preparation of all of the firm's engineering design and construction estimates. A registered engineer in Ohio and New York, Gerber's most recent assignment was that of chief structural engineer in the company's main office in Cleveland, in which position he was responsible for the structural engineering on company projects. He joined Ferguson in 1937.

W. J. Magers has been named general superintendent of SunOlin Chemical Co.'s proposed urea plant. While it is under construction, he will be an operating consultant to the SunOlin Engineering group.

E. L. Crowe has been appointed controller of Fluor Products Co., where he will be responsible for accounting and budgeting. Before joining Fluor, he was a supervising auditor for the Atomic Energy Commission.

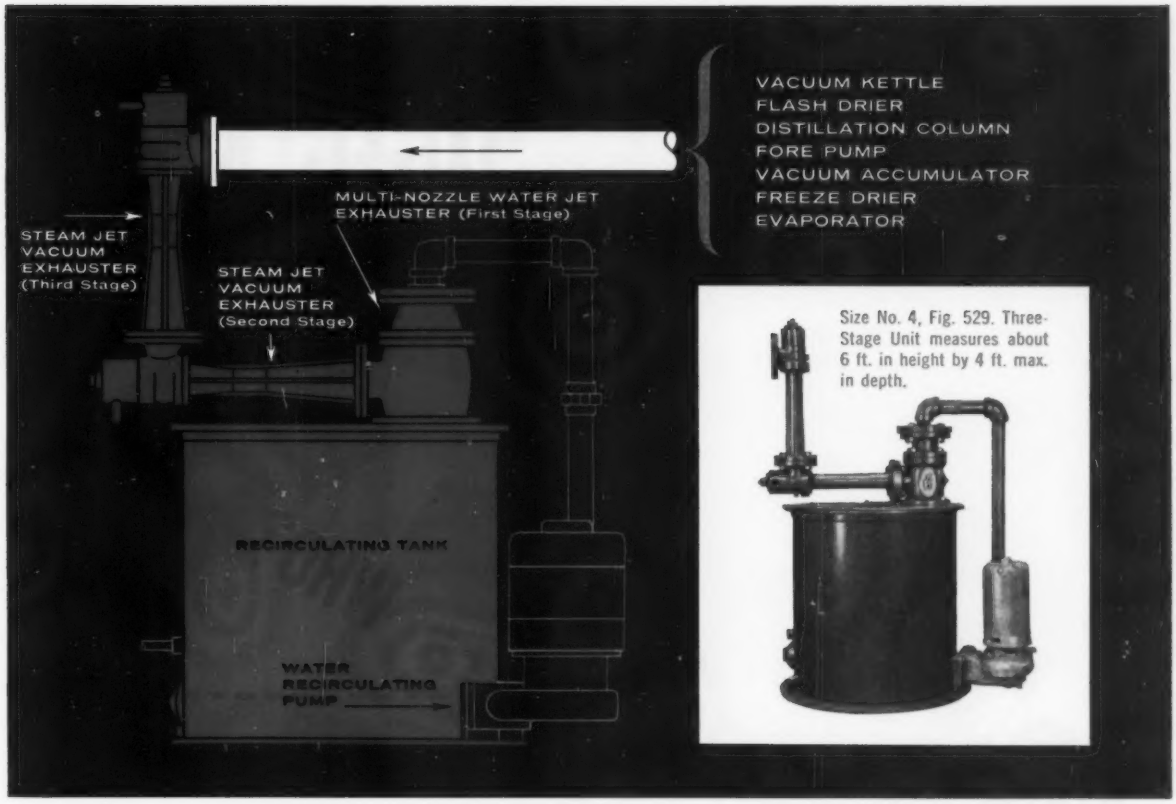
Minos C. Covington has been named assistant secretary and assistant treasurer, Stauffer Chemical Co. Formerly assistant secretary, he has been with Stauffer since 1937.

Henry G. Abbott has been named manager of Esso Standard Oil Co.'s Training division, and **Louis W. Lerda** assistant manager. Abbott has been assistant manager of the division three years. Lerda recently returned from an assignment in South America for Standard Oil Co. (N. J.).

W. R. Wood has been named president of National Constructors Association. Also president of Girdler Construction division, Chemetron Corp., he will serve during 1959.

Donald W. Darnell, chairman, The

For more data on advertised products, use Readers' Service Cards, last page.


VACUUM KETTLE
FLASH DRIER
DISTILLATION COLUMN
FORE PUMP
VACUUM ACCUMULATOR
FREEZE DRIER
EVAPORATOR
MULTI-NOZZLE WATER JET EXHAUSTER (First Stage)
STEAM JET VACUUM EXHAUSTER (Third Stage)
STEAM JET VACUUM EXHAUSTER (Second Stage)
RECIRCULATING TANK
WATER RECIRCULATING PUMP
Size No. 4, Fig. 529. Three-Stage Unit measures about 6 ft. in height by 4 ft. max. in depth.

PRODUCE HIGH VACUUM QUICKLY & ECONOMICALLY

with this "Packaged" Hydro-Steam Unit

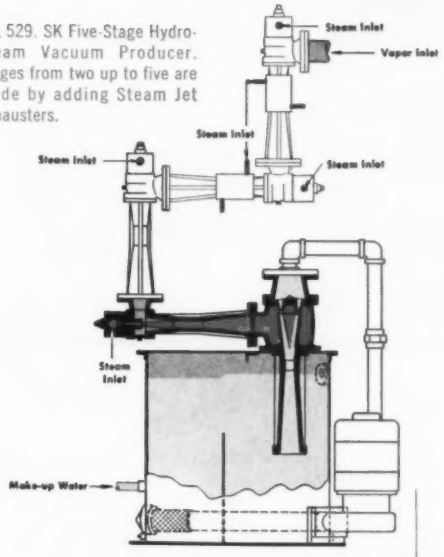


Fig. 529. SK Five-Stage Hydro-Steam Vacuum Producer. Stages from two up to five are made by adding Steam Jet Exhausters.

The unit shown is a "packaged" vacuum producer designed to operate at ground level. Using plant steam and make-up water, it will produce the low suction pressures required for many operations in chemical, food, and petroleum processing plants.

These units are made in a range of sizes in single-stage, two, three, four, and five-stage types. Depending upon size and type, units in this line will provide suction pressures ranging from atmosphere to 1.5 in. Hg abs (single-stage) up to 0.25 mm Hg abs to 25 microns Hg abs (five-stage).

SK "Packaged" Vacuum Producers offer specific, worthwhile advantages. They are simple in construction, are self-contained, compact, require little head room or floor space, are easily installed. Unlike mechanical vacuum producers, contamination presents no problems. They are operated easily, produce vacuum quickly, are economic, can be used intermittently or continuously as desired.

New Bulletin 5H-HS gives complete details on application, construction, operation including suction pressures provided and data on steam consumption and make-up water required. Send for a copy.

JET APPARATUS: Ask for Condensed Bulletin J-1.

ROTAMETERS & FLOW INDICATORS: Ask for Condensed Bulletin M-1.

VALVES: Ask for Condensed Bulletin V-1.

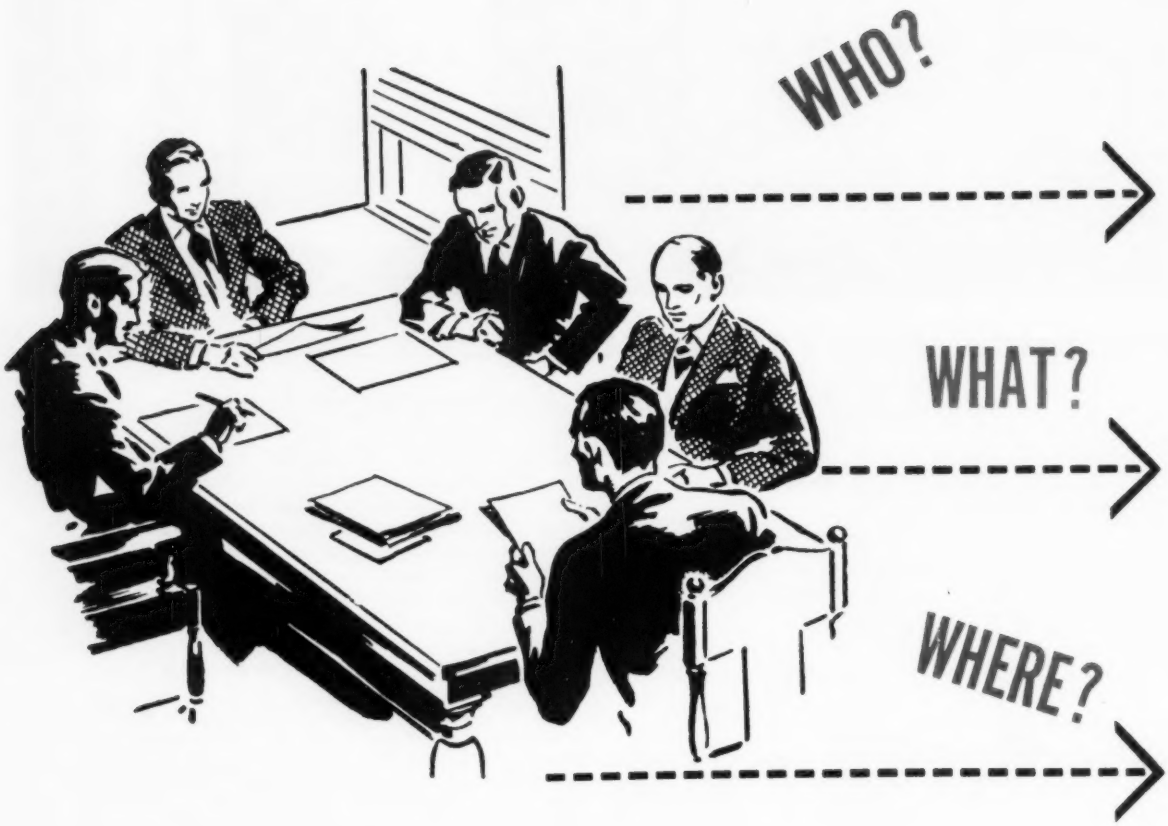
HEAT TRANSFER APPARATUS: Ask for Condensed Bulletin HT-1.

GEAR PUMPS: Ask for Bulletin 17-A.

Schutte and Koerting
COMPANY
MANUFACTURING ENGINEERS SINCE 1876
2257 State Road, Cornwells Heights, Bucks County, Pa.

For more data on advertised products, use Readers' Service Cards, last page.

With Men

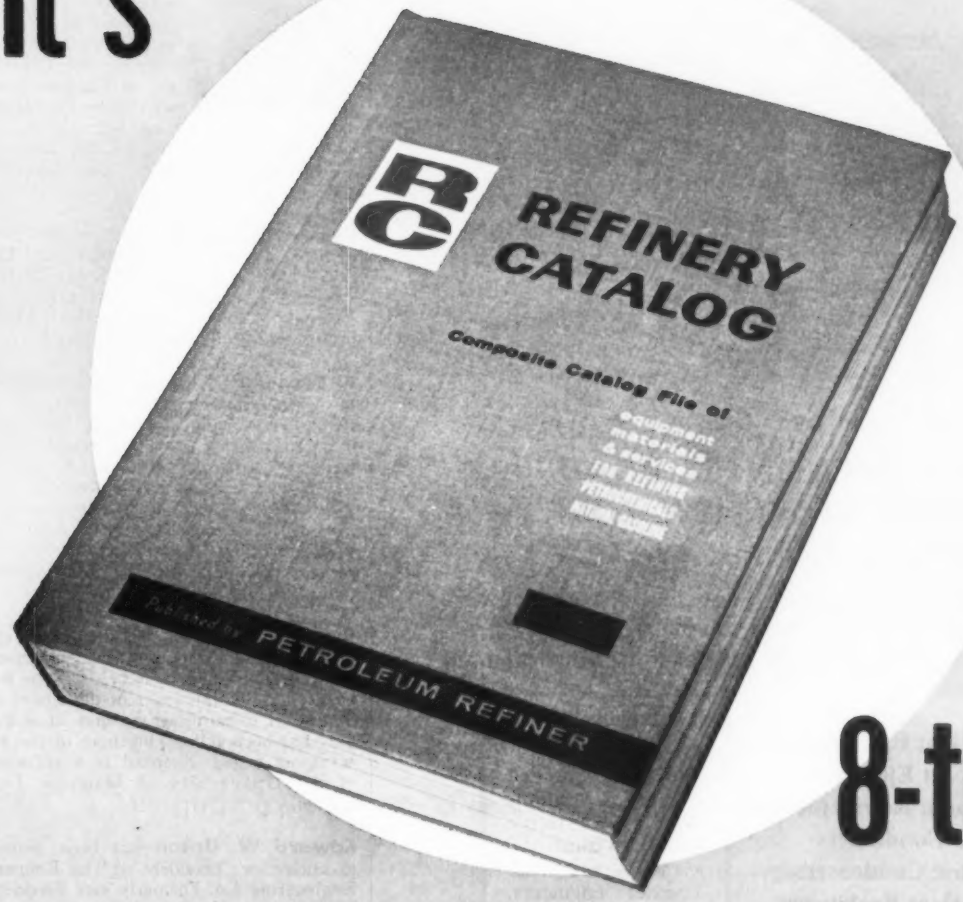


REFINERY CATALOG

Published by Petroleum Refiner

Who Buy And Specify

It's



8-to-1

Look to REFINERY CATALOG for quick answers to your procurement problems in the refining, natural gasoline and petrochemical industry. It's indexed and cross-referenced to save time and eliminate error in planning, buying and specifying for this fast-moving market. That's why buyers and specifiers express a preference of 8-to-1 for REFINERY CATALOG over individual product catalogs.

The next time *you* sit down to figure a job, look *first* in REFINERY CATALOG. You'll find it contributes to greater speed and accuracy.

. . . and here are our new offices—

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With our constantly expanding business has grown the need for larger office quarters to serve you better than ever.

From our new location we will continue to respond promptly to your inquiries for

Heliflow Heat Exchangers
Steam Jet Ejectors
Steam Vacuum Refrigeration
Surface Condensers
Barometric Condensers
Monobolt Heat Exchangers
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Deaerating Heaters

Engineers Wanted!

We have a limited number of positions with a real future open to qualified vacuum and heat transfer engineers. Please send your application to our new address above.

GRAHAM MANUFACTURING CO., INC.

Heliflow Corporation

(Formerly located at 415 Lexington Ave., N. Y. 17, N. Y. and our phone number was MUrray Hill 2-8770)

SINCE 1936

Men

Fluor Corp. Ltd., was elected vice president. New members of the executive committee are: **R. L. Cashen,** vice president, The H. K. Ferguson Co., Cleveland; **W. Earl Dunn,** vice president, Blaw-Knox Co., Pittsburgh; **J. W. Smith,** assistant vice president, The M. W. Kellogg Co., New York, and Darnell.

George F. James has been elected a director of Socony Mobil Oil Co., Inc. He joined the company last year as special assistant to a company vice president. Before that he was with Standard-Vacuum Oil Co. 14 years.

James

Before entering the oil industry, he was associate professor of law and assistant dean at the University of Chicago from which he graduated with B.S. and LL.B. degrees. He received a LL.M. degree in 1934 from Columbia University.

Edward F. Morrill has been elected a vice president of The Standard Oil Co. (Ohio). He is president of Sohio Chemical Co., a wholly-owned subsidiary. A graduate of Case Institute of Technology in 1929, Morrill joined Sohio in 1932.

C. Turner Harding, assistant manager of engineering coordination, Esso Research and Engineering Co., has been appointed chairman of the Security committee, Standard Oil Co. (N. J.). A graduate of Northeastern University with a B.S. degree from Massachusetts Institute of Technology, he joined Esso Research in 1931. In 1954 he achieved his present position, which he will continue to hold.

Clarence D. Shepard has been appointed general counsel, British American Oil Co. Since January, 1957, he has been chief commissioner of the Board of Transport Commissioners, and since last July has been acting chairman of the air transport board. Shepard is a graduate of the University of Manitoba Law School.

Edward W. Upton has been named executive vice president of The Refinery Engineering Co. Formerly vice president of engineering, he joined Treco as executive assistant to the president in 1957 and was promoted the same year. For six years prior to joining Treco, Upton was vice president and general manager of F. H. Maloney Co., Houston. He previously had served 16 years with Byron Jackson Co.

James C. Wishart has been appointed chief accountant for The Atlantic Refining Co.'s Crude Oil Accounting department, with headquarters in Dallas. He joined Atlantic from the New York

For more data on advertised products, use Readers' Service Cards, last page.

DAYS MEAN DOLLARS

Early completion means money saved, more money earned by getting on the line ahead of schedule. This is a big reason why Brown & Root clients come back again and again, through the years.

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Engineers and Constructors

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No. One Wall Street, New York 5, New York
P. O. Box 4140, South Station, Edmonton, Alberta
Pennsylvania Building, Washington, D. C.
Brown & Root Construcciones, S. A., Caracas, Venezuela
Brown & Root de Mexico, S. A. de C. V., Mexico City, Mexico
Brown & Root, LTDA., Santos, Sao Paulo, Brazil
CABLE ADDRESS – BROWNBILT

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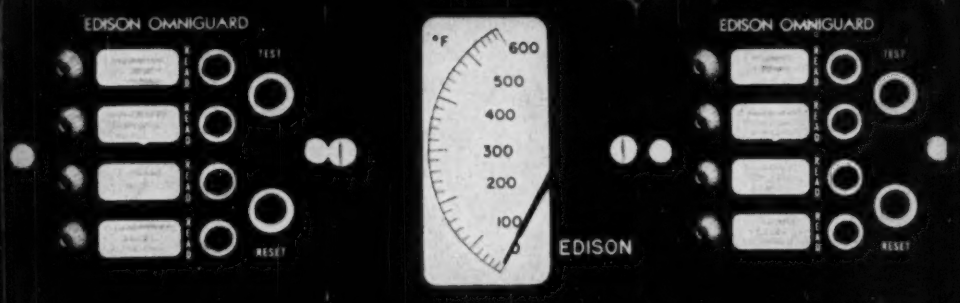
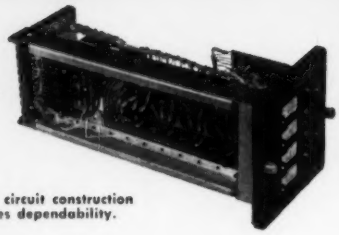
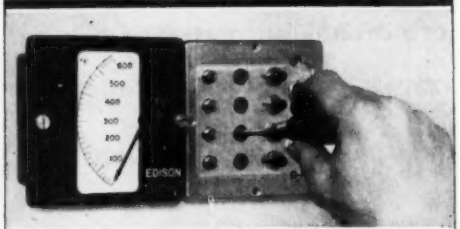




Printed circuit construction increases dependability.

Highest quality components, with no moving parts, assure maintenance-free operation.



Easy access to all components permits quick temperature settings and monitoring system changes – at any time.

Model 310 Edison Omniguard with Model 311 Indicator — a single indicator can read any number of temperature points.

THOMAS A.

EDISON

new model 310 omniguard temperature monitor... unmatched for versatility

The new Model 310 Edison Omniguard provides the simplest, most dependable temperature detection system yet devised... for both small and large installations.

The Omniguard system is reliable... flexible... economical. You order only the plug-in units needed, add new units as your monitoring needs expand.

Check these features of the new Edison Omniguard:

1. VERSATILE: One instrument can be used for both normally open and normally closed annunciator... for alarm or for shutdown of equipment.

2. FLEXIBLE: Quick, inexpensive system changes and additions . . . easy tie-in with any type annunciators or cut-off switches.

3. DEPENDABLE: Rugged design with highest quality components, no fragile moving parts.

4. SIMPLE: Single indicator reads any number of temperatures, needs no periodic adjustment. With a minute's briefing, *anyone* can operate the simple Omniguard monitoring system.

5. LOW COST: Plug-in units can be custom-tailored to your exact requirements . . . order additional units only when needed.

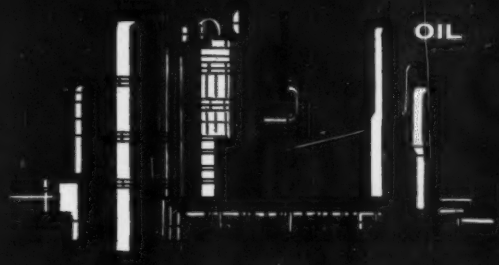
Thomas A. Edison Industries

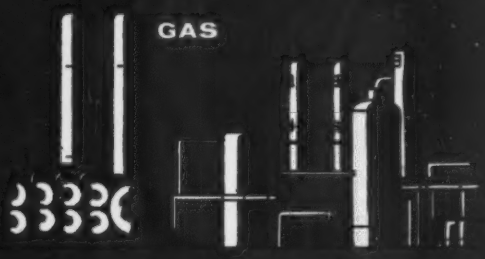
INSTRUMENT DIVISION

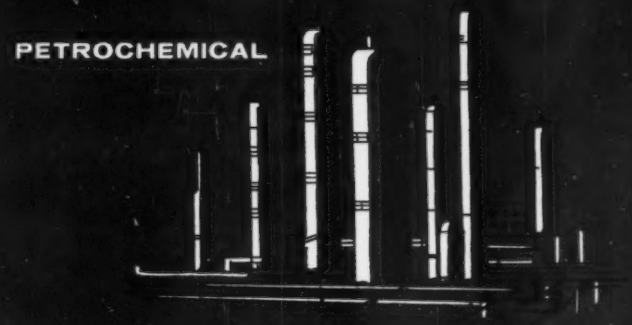
96 LAKESIDE AVENUE, WEST ORANGE, N. J.

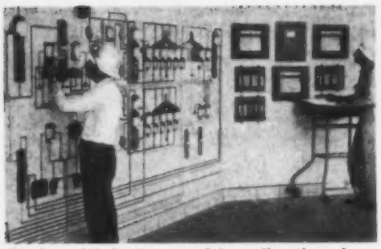
McGRAW EDISON

EDISON ENGINEERING OFFICES ARE LOCATED IN: WASHINGTON—BALTIMORE; CHICAGO; DALLAS; DAYTON; LOS ANGELES



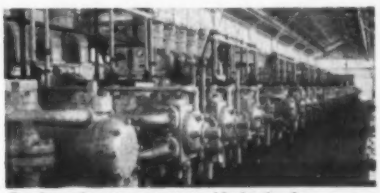






Omniguard indicating panel is easily adapted to miniaturized instrument panel installations for central control.

Detectors provide continuous temperature monitoring of drive motors for shipping pumps.



Omniguard system protects this bank of compressors installed at a natural gas cycling plant.

Oil company power plant uses Edison Omniguard system to protect generating equipment from overheating.

THOMAS A.

EDISON

omniguard system provides reliable, flexible temperature monitoring for oil, gas and petrochemical industries

Throughout your process, wherever temperature is critical, the Edison Omniguard system can protect vital equipment and output quality. It is the simplest and most flexible temperature monitoring system devised.

Plug-in detector units may be installed at key points throughout the process. They can be added or switched without disturbing the system. Typical detector locations include motor and motor bearings in shipping pumps, compressors and generating stations. Individual alarm settings on each point can be changed at any time without special tools.

Indicating panel can be located in central control room, for complete overall process monitoring by a single individual. Alarm system positively identifies trouble point.

The complete system is designed for utmost reliability. There are no moving parts, nothing to wear out.

Edison engineers will be happy to provide assistance in designing the most efficient system to meet your requirements.

For additional information write for publication 3036-C.

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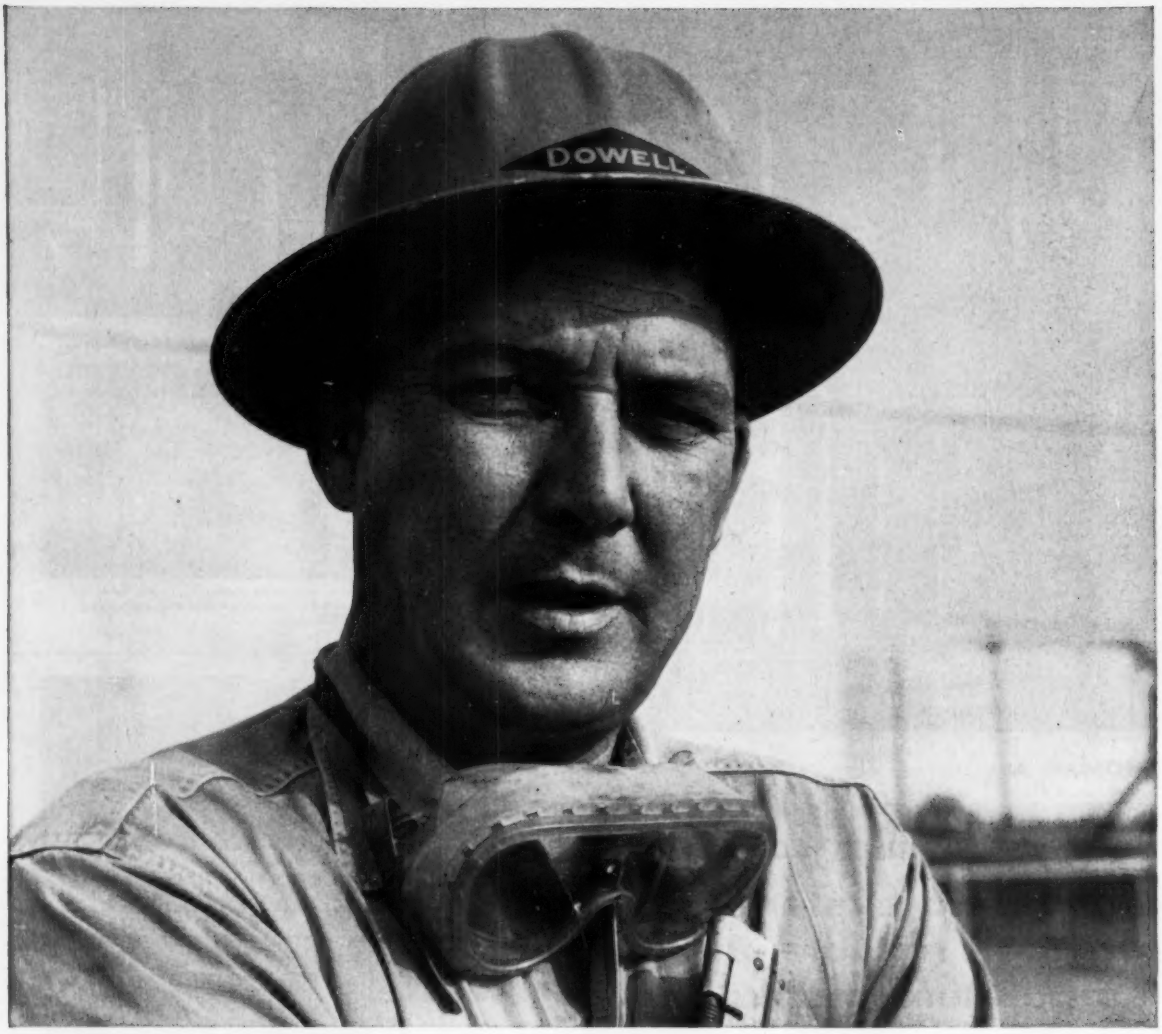


This Man Can Help You Get More Efficiency From Plant Equipment

Efficiency is what you want from your plant equipment, and the Dowell engineer can help you get it. Plants in every major industry—for example, oil refining, chemical, public utility, steel and paper—are getting productive results from *economical* chemical cleaning by Dowell.

To remove scale and sludge from your process equipment, boilers, tanks and piping, Dowell engineers provide knowledge and tools you can get from no other chemical cleaning service. You get cleaning knowledge gained from developing and working with the rigorous cleaning standards of the missile program at Cape Canaveral. You get new tools and chemicals from a continuous research program. For example, Dowell recently introduced a new high-velocity jetting device for cleaning tube bundles.

And you get 20 years' worth of experience in all types of industry from Maine to California. Plant operators find it pays to call Dowell on even the smallest job. But they also know that Dowell has the manpower and equipment to clean the largest and most complex systems.

The Dowell engineer takes pride in doing your job so well that you will continue to call him for your cleaning work. This desire to do your job well covers every facet of service—from seeing that you get solvents exactly as specified, to supervising Dowell's full-time safety program. Every precaution is used to protect your personnel and equipment.

Prompt service and detailed information is yours from any of the 165 Dowell stations and offices. Get more efficiency—economically—with the help of the largest, the oldest, the most experienced chemical cleaning service—Dowell, Tulsa 1, Oklahoma.

Chemical cleaning service for all industry

DOWELL

DIVISION OF THE DOW CHEMICAL COMPANY

For more data on advertised products, use Readers' Service Cards, last page.

Men

office of The Texas Co. He was formerly controller of the Seaboard Oil Co. until its merger with The Texas Co. in June, 1958.

Dr. E. J. Buckler has been named vice president of research and development for Polymer Corp., Ltd. He has been manager of the Research and Development division since 1947. Dr. Buckler received M.A. and Ph.D. degrees at the University of Cambridge.

Edwin H. Brown has been appointed vice president of finance for Commonwealth Oil Refining Co., Inc. He will locate in Commonwealth's home office at Ponce, Puerto Rico. A former director, vice president of finance and treasurer of Clark Oil & Refining Corp., Milwaukee, Brown attended the Fenn College school of business administration.

Dr. R. E. Pennington has been promoted to senior research chemical engineer in Humble Oil & Refining Co.'s Research and Development division, Baytown, Texas. He is engaged in petrochemicals research. Dr. Pennington has a Ph.D. degree in chemical engineering from The University of Texas.

James I. Harper has been named coordinator of chemical manufacturing and sales for Sun Oil Co. He is also president of SunOlin Chemical Co., a Sun-Olin Mathieson Chemical Corp. subsidiary. A graduate of Rensselaer Polytechnic Institute, Harper came to Sun in 1936 as a group leader, Research and Development division. He became assistant superintendent, petrochemicals, at the Marcus Hook, Pa., refinery in June, 1956.

Dr. R. Tracy Eddinger, manager of Eastern Gas and Fuel Associates' research laboratory, Boston, has been elected 1959 chairman of the American Chemical Society's Division of Gas and Fuel Chemistry. **Dr. Richard A. Glenn** of Bituminous Coal Research, Inc., Pittsburgh, was named chairman-elect of the ACS division. **O. P. Brysch** of the Institute of Gas Technology, Chicago, will continue as secretary-treasurer.

Ronald E. Ewing has been appointed director of budgeting and internal auditing for Midland Cooperatives, Inc. He will also have charge of special project analysis and work simplification. He formerly was chief of fiscal planning and general auditor. **Arnold Waller,** formerly petroleum manager, has been named director of refining operations and oil production, including the Midland refinery at Cushing, Okla. He has been with Midland since 1938.

Dr. William E. Bradley, manager of research of Union Oil Co. of Calif., has been elected chairman of the American Chemical Society's Division of Petroleum Chemistry. **Wheeler G. Lovell,** director of automotive products development of Ethyl Corp., was named chairman-elect.

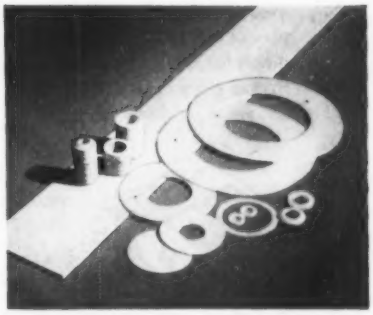
When CHEMICALS enter the PACKING PICTURE

For use on equipment which handles chemicals, we make a wide variety of packing materials to fill different needs. Among them are:

Style No. 4
WHITE ASBESTOS PACKING—for use against hydrochloric, muriatic and phosphoric acids, sulphurous and caustic alkali solutions, for temperatures up to 600 degrees F.

Style No. 5
BLUE ASBESTOS PACKING—for use against sulphuric, benzoic and hydrofluoric acids, caustics, ferric chloride, etc., for temperatures up to 550 degrees F.

"Teflon" Products — "Teflon" does not melt or flow, and is the finest material known for use against solvents, acids, alkalies, caustics, etc. Recommended over a temperature range from —80 to plus 500 deg. F. Tensile strength ranges between 1500 and 2500 P.S.I. Can be used in combination with other sealing materials. Furnished in molded rods, tubes, V rings, solid ring gaskets, sheet, envelope gaskets, tape, O rings, and braided forms.



Style T-5, impregnated packing.

Style T-5B, braided packing.

If you need the solution to a specific problem, we invite you to call upon our service department, which will give your inquiry its immediate attention.

ALLPAX

"The Packing that Packs All"

SEND FOR OUR NEW CATALOG — TODAY!

A complete line of packing, tools, gasket materials. Ask for dealer information and price schedules.

THE ALLPAX COMPANY, INC.
160 Jefferson Ave., Mamaroneck, N. Y.
CANADIAN DISTRIBUTORS: Albion Asbestos Packings Ltd., Montreal 8, Quebec

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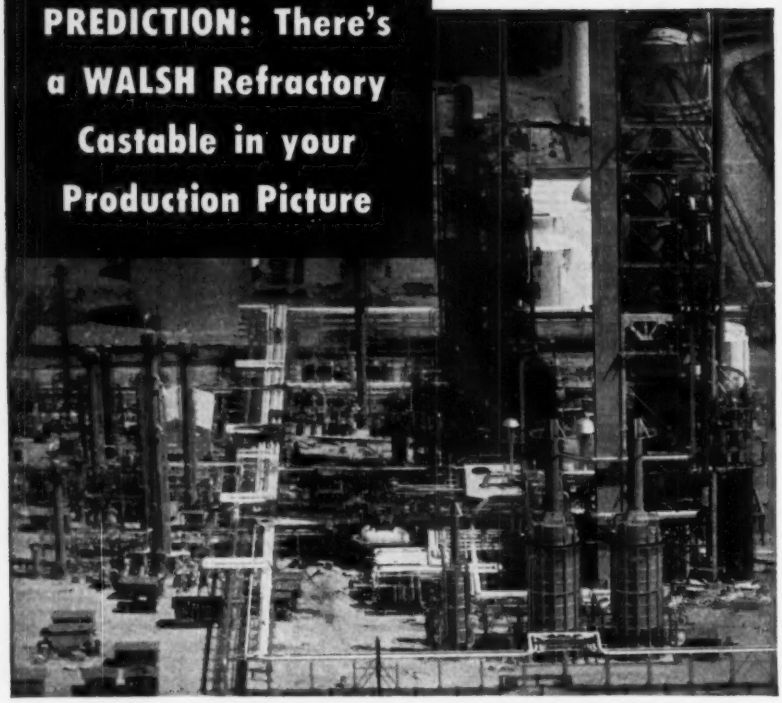
PREDICTION: There's a WALSH Refractory Castable in your Production Picture



Assurance Of New Highs In Performance At Lower Cost

Whether your refractory castable practice calls for a two-component lining or consideration of a "one shot" system later on—you'll find the right Walsh product for your purpose. Modern as tomorrow, every Walsh Castable offers absolute homogeneity—the result of production control methods that insure the perfect union of all ingredients for efficient service throughout a longer life. The whole money-saving story is available from your nearest Walsh representative. Or, write us direct, today.

WALSH EXTRA STRENGTH H & B CASTABLE (Service Type) For highly abrasion-resistant, monolithic, working linings in catalytic regenerators, reactors, and other refinery equipment.

WALSH LITE WATE INSULATING CASTABLE NO. 50. Features high bulk density while retaining a low K factor. Recommended for back-up use in two-component linings.

WALSH LITE WATE INSULATING CASTABLE NO. 70. Higher strength and a low K factor makes this insulating castable highly desirable for "one shot" linings.

All Walsh Castables are characterized by extreme "flowability", excellent nozzle compaction, lower rebound loss . . . plus greater strength, better bond . . . throughout the complete temperature range.

Send for New Illustrated Castable Bulletin

WALSH
REFRACTORIES CORPORATION
101 Ferry Street · St. Louis 7, Missouri
SPECIALISTS IN REFRACTORIES OF HIGH BULK DENSITY AND LOW POROSITY

Men

Dr. Bernard M. Sturgis of E. I. duPont de Nemours & Co., and **Dr. H. J. Passino** of The M. W. Kellogg Co., will continue as secretary and treasurer, respectively.

C. E. Smith Jr., assistant superintendent of the Operations Services division, Humble Oil & Refining Co.'s Baytown, Texas, refinery, has been assigned to the Houston office as operations advisor to **Charles F. Jones,** manager of the Manufacturing department. He will assist Jones in matters relating to current operations at the Baytown refinery, and will be in charge of the Special Products Manufacturing and Fuel Oil Terminals division. Smith joined Humble at Baytown in 1940.

Nathan Fragen, director of chemicals research and development at Whiting Research laboratories, Standard Oil Co. (Ind.), has been appointed to the editorial advisory board of the *Journal of Applied Polymer Science*. The journal, the first number of which appears this month, features articles reporting applied research on plastics. Dr. Fragen is a member of ACS and AIChE, and has a Ph.D., degree in chemical engineering from the University of Michigan.

H. C. Tett has been named managing director of Esso Petroleum Co., Ltd. Formerly a managing director and chief executive of Esso Petroleum Co., he is a graduate of the Royal College of Science, London, and holds the Diploma of Imperial College for research work on combustion and tetraethyl lead. Tett joined Esso Petroleum Co. in 1928 as an assistant in the Technical Sales department.

– Deaths –

Dr. William Reed Veazey, 75, retired director of The Dow Chemical Co., died December 20 at Youngstown, Ohio, where he had lived for more than two years. He retired in 1953 following 37 years of service, including 26 years as a director. The company's Texas division Research center at Freeport was named for him. Dr. Veazey was on the teaching staff of Case Institute of Technology for 29 years. He was head of the Department of Chemistry and Chemical Engineering for eight years.

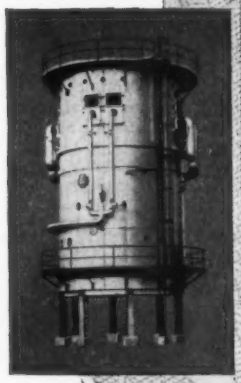
H. T. Goss, 58, vice president of Arkansas Fuel Oil Corp. and Arkansas Pipeline Corp., died unexpectedly of a heart attack at his Shreveport home February 10. He joined the Empire companies at Bartlesville, Okla., in 1922 and spent his entire business life with the Cities Service organization. Goss was a mechanical engineering graduate of Texas A & M College.

Harry D. Collier, 82, former president and board chairman, Standard Oil Co. of California, died January 1, in San Francisco. He joined the company in 1903 and became company president in 1940.

For more data on advertised products, use Readers' Service Cards, last page.

HYDROGEN FROM NATURAL GAS

for producing AMMONIA and METHANOL



Since its introduction ten years ago, the Chemico *gas reform furnace* has often proved the most efficient and economical first step in the production of ammonia, methanol and high purity hydrogen from natural gas. The unique design of the Chemico *gas reform furnace* eliminates thermal expansion problems, assures easy control during operation and requires minimum maintenance.

Now there are more than 60 furnaces in operation, and another 10 are in the design or construction stage. These units range in capacity from 50,000 to 8,000,000 standard cubic feet per day of hydrogen plus carbon monoxide. For any process which requires hydrogen, the Chemico *gas reform furnace* may well prove the most economical means of obtaining the necessary quantities. Write to Chemico for further information.

WRITE TODAY FOR A COPY OF THE NEW CHEMICO GENERAL BULLETIN

CHEMICAL CONSTRUCTION CORPORATION
525 West 43rd Street, New York 36, New York

CHEMICO

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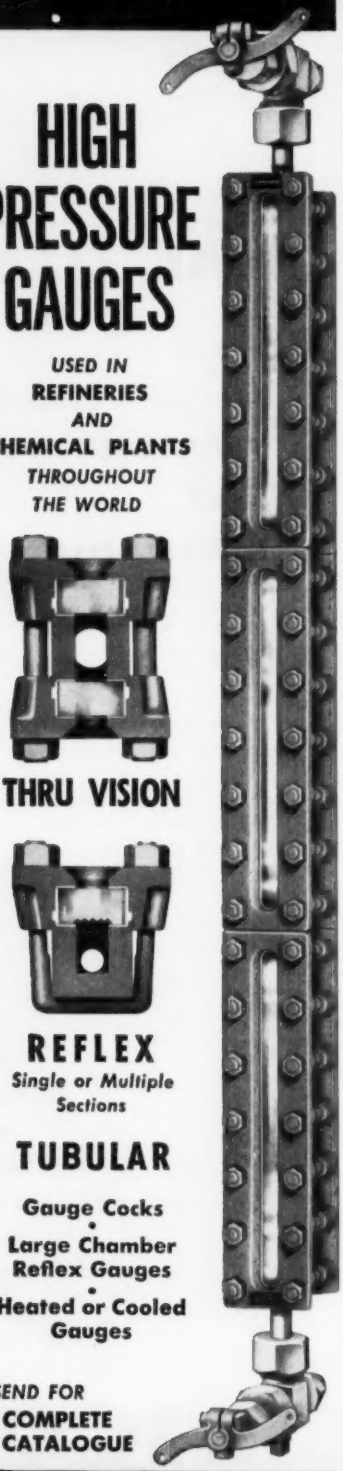
USED IN REFINERIES AND CHEMICAL PLANTS THROUGHOUT THE WORLD



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Single or Multiple Sections

TUBULAR

Gauge Cocks

Large Chamber Reflex Gauges

Heated or Cooled Gauges

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16 Hudson St., New York 13, U.S.A.

New Books...

Heater-Tube Thickness

"Recommended Practice for Calculation of Heater-Tube Thickness in Petroleum Refineries," API publication RP 530 is available. This is the First Edition, 1958. It prescribes recommended procedures for calculating the required wall thickness of petroleum-refinery heater tubes for use at elevated temperatures. Utilization of these procedures results in the determination of both design (initial) and retiring (final) tube thickness for corrosive and noncorrosive services. This recommended practice is not intended to cover calculations relating to tubes less than two inches in outside diameter, and it is limited to designs where the heat density is 8,000-Btu-per-square-foot per hour, or greater.

(API, *Recommended Practice for Calculation of Heater-Tube Thickness in Petroleum Refineries (Publication RP 530)*, Publications department, American Petroleum Institute, 50 West 50th St., New York 20, N. Y., $6.00.)

Work Injuries Discussed

"ASA Publication Z16.1-1954" discusses work injuries in 100 actual injury cases. Are the following cases work injuries?

- A linesman was found dead on a pole. It couldn't be determined whether he died of heart failure or electric shock.
- A worker gave blood to Red Cross on company time and was found to be allergic to adhesive tape.
- An intoxicated worker climbed on top of a boiler and died from heat and intoxication.

The question is answered in this new American Standards Association book. Each case has been interpreted by a committee to give a ruling on reportability under the 1954 revision of American Standard, Z16.1, "Method of Recording and Measuring Work Injuries."

(ASA, *ASA Publication Z16.1-1954*, American Standards Association, PR11, 70 East 45th St., New York 17, N. Y., $.70.)

Defining Manager's Job

"Defining the Manager's Job" is the American Management Association's manual of position descriptions. A well-managed organization defines the functions and responsibilities of its executives. These position descriptions—organized in specific, practical terms—contribute to sound operations. This AMA research study reports on the style, content and language of position descriptions. Based on a survey of 140 companies, the book reproduces about 150 actual position descriptions for all managerial levels. These descriptions give the reader basic data for reviewing organization structure.

(Bennet, C. L., *Defining the Manager's Job*, American Management Association, Inc., 1515 Broadway, Times Square, New York 36, N. Y., 447 pages, $9.00.)

Scintillation Counting

"Liquid Scintillation Counting" is the first volume ever published on this technique of radiation measurement, and it summarizes the theory, applications and techniques of the subject. It covers all the advances in the field and reviews literature and progress through 1957. This book will help all workers entering the liquid scintillation field—scintillation counters being one of the versatile and important instruments in modern tracing techniques.

(Bell, C. G., Jr., and Hayes, F. N., *Liquid Scintillation Counting*, Pergamon Press, Inc., 122 East 55th St., New York 22, N. Y., 292 pages, $10.00. For sale by Gulf Publishing Co., P. O. Box 2608, Houston 1, Texas, U.S.A.)

Lab Distillation Practice

"Laboratory Distillation Practice" describes the up-to-date methods and techniques of distillation being used in progressive laboratories, and is offered as a practical manual to supplement the elementary account of distillation in textbooks of preparative chemistry. The construction and operation of a range of apparatus covering laboratory needs is described. Particular attention is given to the control devices essential to modern equipment. Separate chapters deal with the techniques of low-temperature and low-pressure distillation. Azeotropic and extractive distillation and their application to separations of uncommon difficulty are covered. Sufficient description of continuous distillation is included to allow its value as a small-scale method to be appreciated.

(Coulson, E. A., and Herington, E. F. G., *Laboratory Distillation Practices*, Interscience Publishers, Inc., 250 Fifth Ave., New York 1, N. Y., 166 pages, $4.50. For sale by Gulf Publishing Co., Box 2608, Houston 1, Texas, U.S.A.)

Control System Engineering

"A Simplified Technique of Control System Engineering" is written for those interested in process control and in finding out what an analysis of a system can tell them. The reader should have some experience with industrial instrumentation and some knowledge of control of quantities such as temperature, pressure and flow. No mathematical control theory is needed. The practical system is the book's subject—how it is designed to work, how to study its performance and how to make it work better. Dynamic analysis of a system can be done with pencil and paper. How it is done may seem a mystery to one not familiar with the mathematics of pencil-and-paper methods. However, a person who can read a graph and work a simple formula can understand the basis for dynamic analysis, how the results are obtained, and what they mean in relation to the system.

(Tucker, G. K., and Wills, D. M.,

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Bulletin E-1 shows Vogt's advanced designs in heat exchangers, reactors, oil chillers, crystallizers, pressure vessels, steam generators and ice making and refrigerating machinery for countless applications in petroleum refineries, chemical plants, power plants and related industries.

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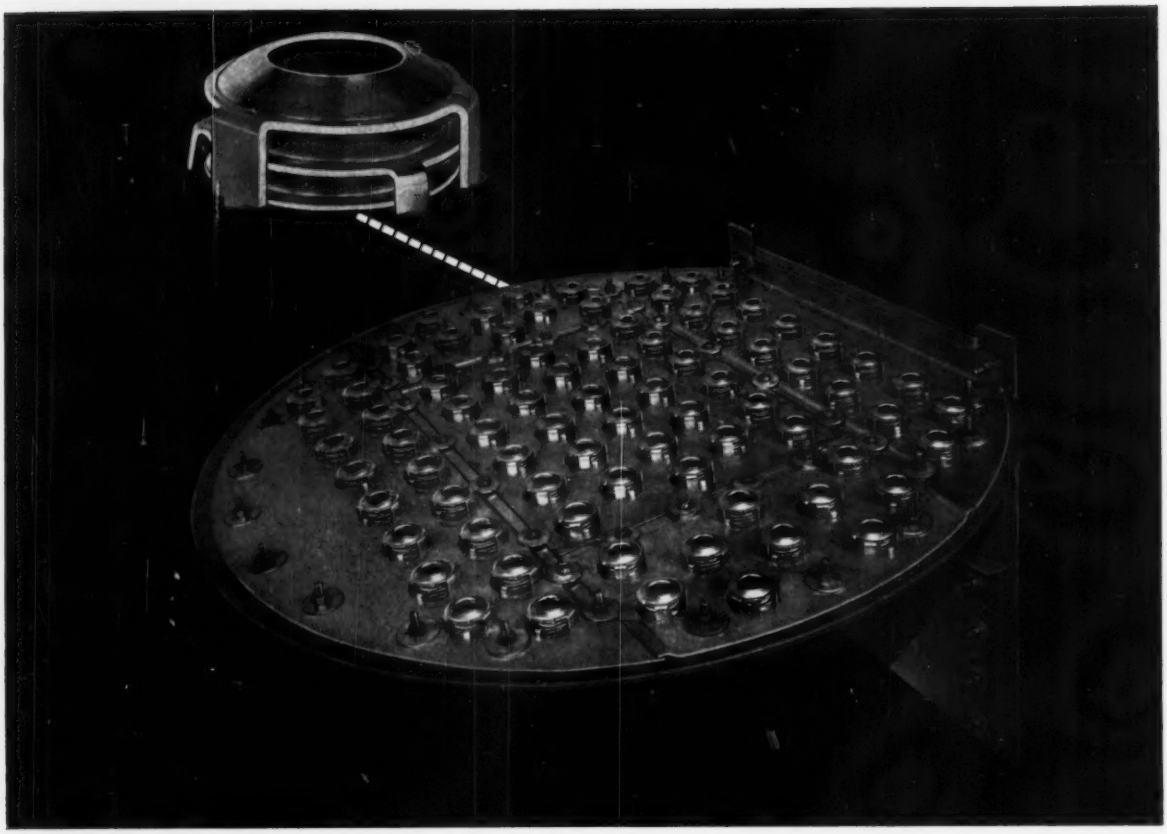
STREET_____

CITY_____ State_____

24A-GPR



Something NEW...in Valve Tray Design

OPERATING DATA REVEALS GLITSCH BALLAST TRAYS GIVE GREATER TURNDOWN RATIO — OVER-ALL OPERATING EFFICIENCY

The Glitsch Ballast Tray is a new type valve tray that has all the good features both of conventional bubble cap trays and perforated trays, and yet eliminates the many inherent problems encountered with ordinary valve type trays.

Data secured during operational runs to determine the efficiency of the new Glitsch Ballast Tray established the following: (1) The efficiency of the tray from very low vapor rates (within ten per cent of flood point) up to moderate vapor rates is higher than any other tray of comparable capacity; (2) the turndown ratio of the Glitsch Ballast Tray (the ratio of maximum to minimum vapor rates at which a high efficiency is maintained) is at least 9.0.

The Glitsch ballast unit is designed to function as a variable orifice and thereby provide a staging of the vapor through the various rates of flow. This design permits uniform distribution of vapor through the liquid throughout a wide range of capacity; optimum vapor velocity through the liquid over a wide range of flow rates; large turndown ratio by progressive staging of the vapor opening from low to increasingly high fluid rates, and establishes a primary pressure drop at the vapor-liquid interface to obtain maximum tray efficiency.

Increase the efficiency of your next distillation units. Specify new Glitsch Ballast Trays. For more information and operating data on the ballast tray, contact your nearest Glitsch sales representative or Glitsch – Dallas, Texas.

Specify Glitsch **TRUSS-TYPE®** *Trays*

Fritz W. Glitsch & Sons, Inc.

4900 SINGLETON BLVD. ⋮ DALLAS 2, TEXAS

Glitsch "SINGLE ENGINEERING RESPONSIBILITY"

SALES OFFICES: *New York • Cleveland • Los Angeles • Tulsa • Dallas • Houston • Baton Rouge • Uxbridge & Sarnia, Ontario, Canada*

For more data on advertised products, use Readers' Service Cards, last page.

Books

A Simplified Technique of Control System Engineering, Minneapolis-Honeywell Regulator Co., Brown Instruments division, Wayne and Windrim Avenues, Philadelphia 44, Pa., 303 pages, $5.00.)

Chemistry Made Easy

"Chemistry Made Easy" will prove of great value to all employed in the petrochemical industry. It covers the three main branches of chemistry: general, inorganic and organic. Each part includes more than 20 chapters full of information, tables, illustrations and chemical equations. At the end of each chapter are questions which will enable the reader to evaluate his progress. It is written in a simple and enjoyable style, avoiding the stiff and rigorous textbook treatment. Those with no technical or scientific education will gain a working knowledge of chemical fundamentals by reading the book. It will also serve as a refresher and ready reference.

(Snell, Cornelia T., and Snell, Foster D., *Chemistry Made Easy,* Chemical Publishing Co., 212 Fifth Ave., New York, N. Y., 262 pages, $10.00. For sale by Gulf Publishing Co., P. O. Box 2608, Houston 1, Texas, U.S.A.)

The Great Oildorado

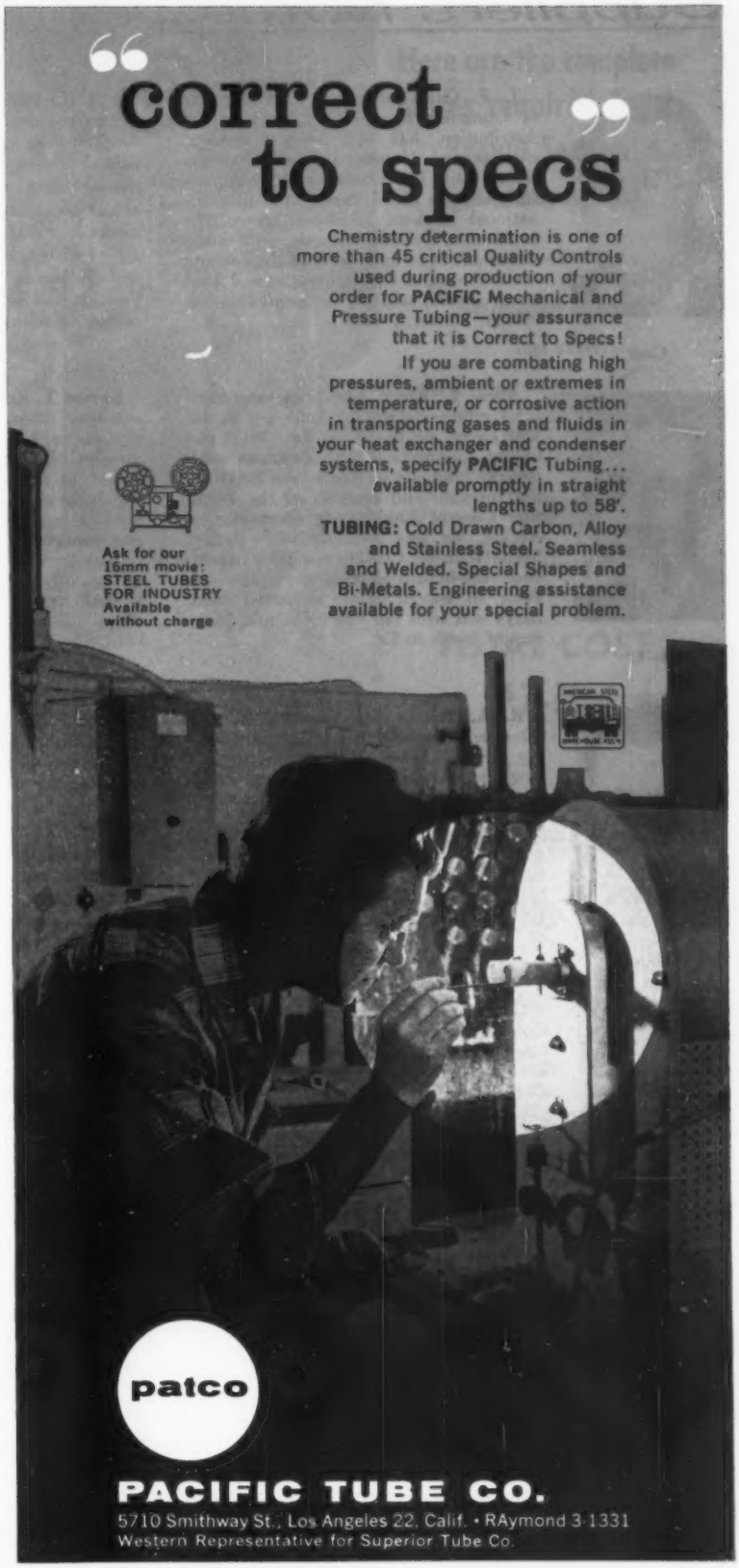
"The Great Oildorado" tells the story of the lusty years of America's first oil rush in Pennsylvania. It plunges into the mud-and-champagne buoyancy of that fabulous boom town, Pitthole, whose most notorious citizens were Ben Hogan, "the wickedest man in the world", and beauteous French Kate. You can almost hear the whoosh of the gushers as she tells the stories of the men who came running at the sound of riches, and the women who followed them. Skyrocket millionaires, swindlers, industrialists, artists—all throng these pages. There was Coal Oil Johnny, who became the playboy of the eastern world; John D. Rockefeller, who built an empire on oil; and the tragic John Wilkes Booth, whose connection with the Pennsylvania oil rush is a dramatic and surprising one.

(Dolson, Hildegarde, *The Great Oildorado,* Random House, 457 Madison Ave., New York 22, N. Y., 301 pages, $3.95.)

Inspection of Equipment

"Guide for Inspection of Refinery Equipment, Chapter VII," on heat exchangers, condensers, and cooler boxes, is available from the American Petroleum Institute. This is the First Edition, 1958. This chapter includes a general description of types of equipment, reasons for inspection, causes of deterioration, frequency of inspection, preliminary work and tools, methods of inspection, limits of thickness, and records and reports.

(API, *Guide for Inspection of Refinery Equipment, Chapter VII,* Publications department, American Petroleum Institute, 50 West 50th St., New York 20, N. Y., $2.00.)


"correct to specs"
Chemistry determination is one of more than 45 critical Quality Controls used during production of your order for PACIFIC Mechanical and Pressure Tubing—your assurance that it is Correct to Specs!
If you are combating high pressures, ambient or extremes in temperature, or corrosive action in transporting gases and fluids in your heat exchanger and condenser systems, specify PACIFIC Tubing... available promptly in straight lengths up to 58'.
TUBING: Cold Drawn Carbon, Alloy and Stainless Steel. Seamless and Welded. Special Shapes and Bi-Metals. Engineering assistance available for your special problem.
Ask for our 16mm movie: STEEL TUBES FOR INDUSTRY Available without charge
patco
PACIFIC TUBE CO.
5710 Smithway St., Los Angeles 22, Calif. • RAymond 3-1331
Western Representative for Superior Tube Co.

For more data on advertised products, use Readers' Service Cards, last page.

Suppliers Notes...

Carr

L. E. Carr, for many years manager of Cummins Engine Co., Inc.'s export distribution, has been named resident manager of Cummins Diesel International, Ltd. The newly-formed company will promote diesel engine sales in international markets. Headquarters will be in Nassau, Bahama Islands, with additional offices to open soon in Europe and South America. Company sales and service personnel will all be located in the foreign offices.

Barry

Allen I. Barry has been appointed sales representative for Infilco, Inc. He will cover all the New England states except Connecticut. A chemical engineering graduate of Rensselaer Polytechnic Institute and member of the Pollution Control Engineering committee of AIChE, he was formerly with Badger Manufacturing Co. He has sales experience in industrial process equipment. Prior to entering the industrial field, Barry was with the Pfizer Co. and Monsanto Chemicals Co.

Mercer

R. A. Mercer has been named city sales manager for Jones & Laughlin Supply division's new sales office in Los Angeles. The office opened January 2. Mercer began with the company as storeman at Bushton, Kan. in 1951. He became a salesman in 1952 and later transferred as salesman to Hill City, Kan. Williston, N. D.; Billings, Mont.; and Wichita, Kan. City sales manager at Cleveland since 1957, he is a graduate of the University of Kansas.

Jamison

George B. Jamison has been named divisional manager for the Gulf division, Crouse-Hinds Co. The division includes the Houston region, including Corpus Christi, and the New Orleans region, including Baton Rouge. He will supervise the company's sales operations in Mexico. With the company since 1944, Jamison is a graduate of The University of Texas with a B.S. degree in electrical engineering, and a registered professional engineer in Texas.

Quirk

John M. Quirk has been appointed applications engineer for capacitance level instrumentation and associated control systems at Robertshaw-Fulton Controls Co., Aeronautical and Instrument division. His responsibilities will cover industrial and other applications of level control instrumentation and systems. Formerly with Fluor Corp. Ltd., Quirk attended Northwestern University, and completed advanced studies at U.C.L.A. in petroleum refinery engineering, electronics, metallurgy and electrical engineering.

Karassik

I. J. Karassik has been appointed consulting engineer and manager of planning for Worthington Corp.'s Harrison division. Formerly consulting engineer and assistant to vice president, Karassik will act as consulting engineer to all departments in the Harrison division. A graduate of Carnegie Institute of Technology with B.S. and M.S. degrees, he joined Worthington in 1934 as assistant to the consulting engineer on centrifugal pumps.

Kehoe

Burton T. Kehoe has been named sales manager of packaged air conditioning equipment for the Unitary Equipment division of Carrier Corp. Formerly assistant to the general manager, Kehoe will be in charge of air conditioning and heating equipment for both residential and commercial application. He joined Carrier in 1948 as general attorney, and is presently administrative manager of United Engineering of Miami, and a director of Air Conditioning Corp., Louisville, Ky.

Houpt

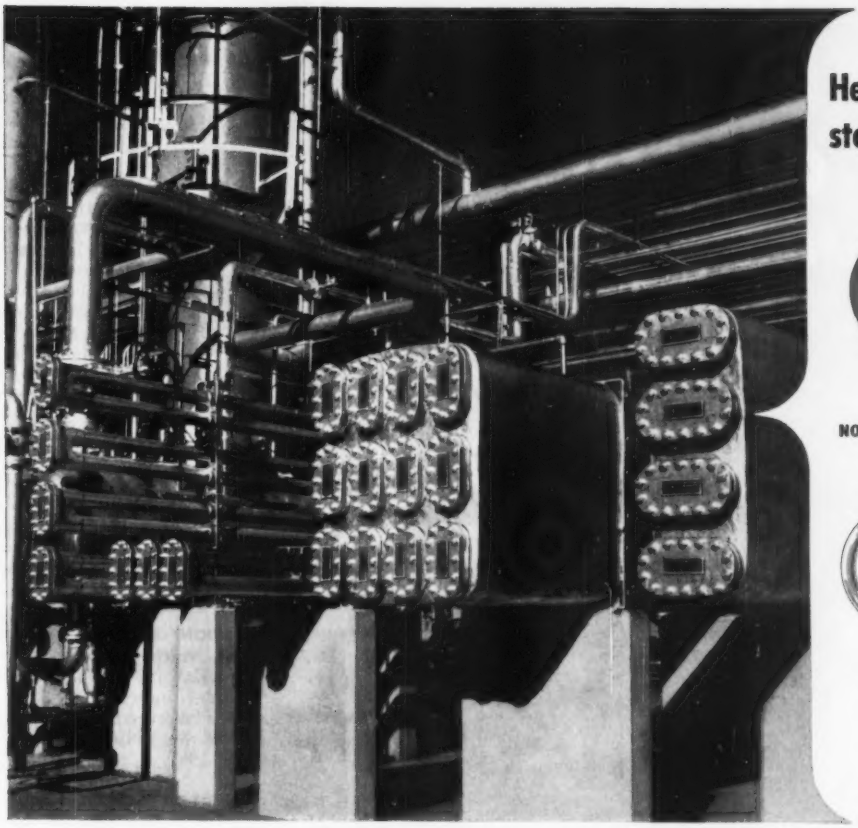
Frank P. Houpt has been named manager of Fisher & Porter Co.'s new System Application department. He will be responsible for direction of systems engineers and for planning and coordinating the systems program for the process and missiles industries. Formerly manager of application engineering, he has been with F&P 13 years. Houpt attended Duke and Columbia Universities and is a member of ISA and ARA.

Elms

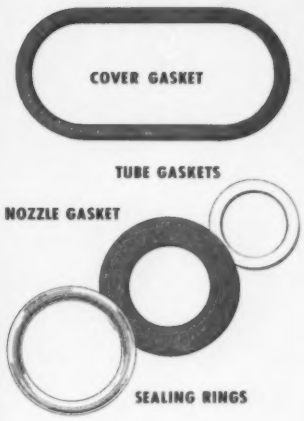
Richard A. Elms has been named assistant advertising and sales promotion manager for Beckman Systems Division. A graduate electrical engineer from the University of Oklahoma, where he also did graduate work in journalism, Elms received a medal as the outstanding Oklahoma University senior in his final year there. Prior to joining Beckman he was with Southwestern Bell Telephone Co. and the Portland, Ind. *Graphic*, where he served as that newspaper's editor.

Rockwell

Willard F. Rockwell, Jr., president of Rockwell Manufacturing Co., will head a heavy machinery industry committee for fund-raising on behalf of what is said to be the largest campaign of citizen education in foreign policy ever undertaken by private auspices in this country. The Foreign Policy Association is marking its 40th anniversary with its first national appeal for funds. Rockwell has been a director of Rockwell Manufacturing since 1940 and president since 1947. He is a graduate in industrial engineering from Pennsylvania State University.



Here are the complete stores required for a Brown Section



TOTAL COST
$7.70

BROWN FINTUBE HEAT EXCHANGERS
save their cost in parts alone!

- Any plant using Brown Fintube Heat Exchangers saves their costs in parts alone by meeting all operating duty for pressures up to 600 PSI *with one basic unit.*
- This ability to use the same Brown Fintube section, combined in proper series, to meet any application, reduces stores to one set of parts—even for scores of different duties. Such savings, plus the advantages of no obsolescence, reduced fouling, and maintenance, are reasons why so many plants are changing to high efficiency Brown Heat Exchangers.
- Let us show you what heat exchanger standardization really means . . . and how little it costs. Mail coupon for Specification Manual M-100. Obtain complete specifications on Brown Fintube heat exchangers which will reduce your operating and maintenance costs.

HEAT EXCHANGE SURFACE
BROWN FINTUBE
HEAT TRANSFER PRODUCTS

BROWN FINTUBE CO.

302 HURON STREET • ELYRIA, OHIO
Telephone: FAirfax 3-3291

FREE SPECIFICATIONS MANUAL!

Please send a copy of your Heat Exchanger Specifications Manual M-100 which will help us save costs by standardizing on one basic heat exchanger unit.

NAME_____ TITLE _____

FIRM _____

ADDRESS _____

CITY _____ ZONE _____ STATE _____

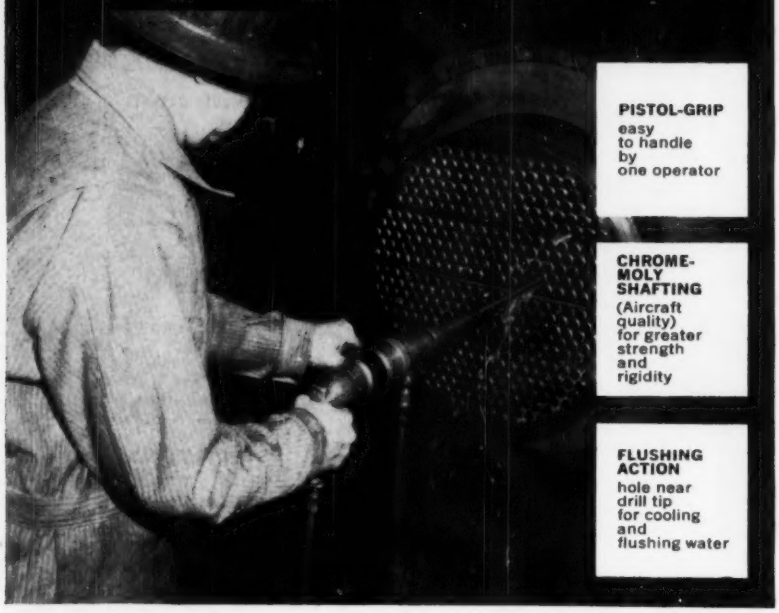
PR 359

THERE'S *MORE* TO HEAT EXCHANGERS THAN INITIAL PRICE!

For more data on advertised products, use Readers' Service Cards, last page.

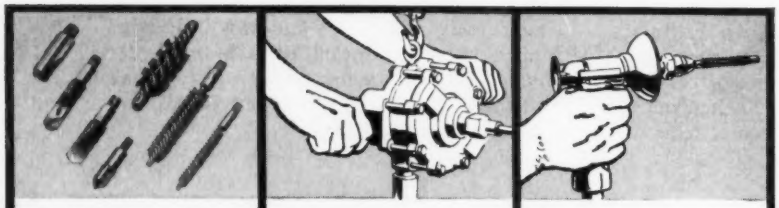
newest ELLIOTT tube cleaner

lightweight! air-driven!


PISTOL-GRIP
easy to handle by one operator
CHROME-MOLY SHAFTING
(Aircraft quality) for greater strength and rigidity
FLUSHING ACTION
hole near drill tip for cooling and flushing water

for condenser and heat exchanger tubes

Lightweight. Powerful. Air-driven. Trigger-action control with speed governor to prevent shaft-whip. High-speed motor reduced through planetary gears to 1500 rpm. Integral water-feeding attachment with finger-action valve which controls flow of cooling water into hollow shaft and drill or brush. Built-in oil reservoir. Send for tube cleaner bulletin Y-48.



DRILLS AND BRUSHES FOR VARIED NEEDS
Brushes for light deposits. Four types of drills clean light, hard-heavy, hard-light, and gummy deposits.

SUSPENSION TYPE
Air, steam or electric heavy-duty motor, for removing hard, heavy deposits. Ball bearings absorb thrust in either direction.

ELLIOTT JIFFY GUN
For extra-fast cleaning of light deposits in tubes ½ in. to 1¼ in. Air or water pressure shoots nylon brushes or rubber plugs through tubes.

ELLIOTT Company
Lagonda Plant—Springfield, Ohio

Y9-1

Suppliers

TUBE FORGINGS OF AMERICA, INC., has named **William E. Hutchins** Southwest district manager with headquarters in Houston. He will serve as plant representative and work directly with Tube Forgings distributors in Texas, Louisiana and Oklahoma, giving particular attention to the petroleum, natural gas and construction industries. Hutchins has 10 years' experience in industrial piping, the last three with Tube Forgings' Western sales staff, Portland.

Hutchins

CHASE BRASS & COPPER CO. has named **Walter L. Smith** assistant to the president. Formerly vice president-operations, Smith plans to retire in August, and the move was made to allow an orderly transition within the division.

BEAIRD INTERNATION, INC. has named **B. D. Cass** and **Murphy Horton** sales engineers in the Calgary office. Horton was formerly chief inspector at J. B. Beaird Co., Inc.'s Shreveport plant, and Cass has been in the Tulsa compressor sales office since 1957.

THE OHIO INJECTOR CO. has opened branch warehouses in Los Angeles and Houston. The Los Angeles facility will be managed by **W. E. McComas** and the Houston operation by **J. E. Marrin.**

CLARK BROS. CO. has elected **F. H. Ford** vice chairman of the Gas Turbine group, National Electrical Manufacturers Association. He is assistant manager of the Marketing department, turbines, of the Turbo Product division.

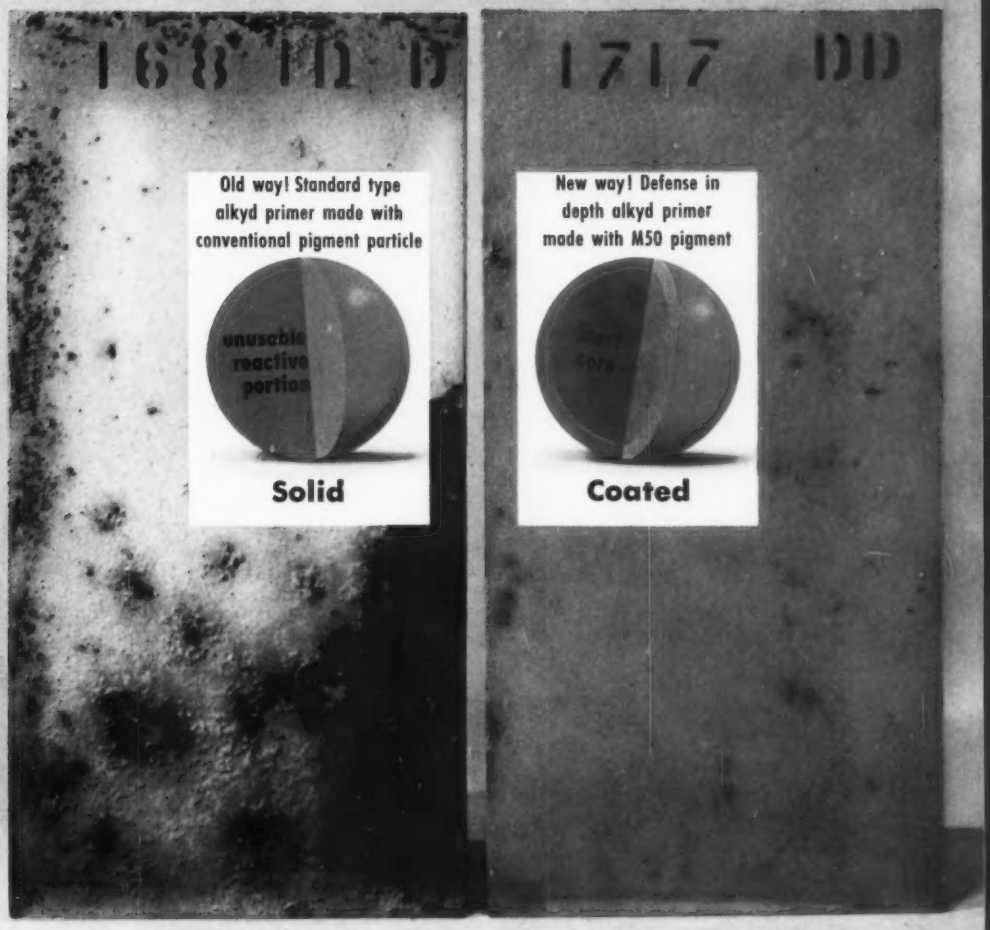
ALLIS-CHALMERS MANUFACTURING CO.'s Industries group has appointed **S. B. Lamica** manager of the Jacksonville, Fla., district. He has been a sales representative in the Tampa district office since 1952.

FISHER SCIENTIFIC CO.'s New York plant has promoted **Claude A. Pamplin** to general sales manager in charge of domestic and export sales, and **Philip C. Stoddard,** operations manager responsible for all internal operations.

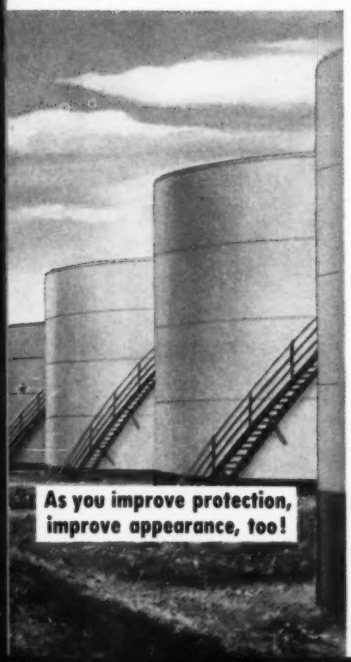
CALUMET & HECLA, INC.'s Wolverine Tube division has reorganized its sales districts as follows:

Richard B. Flynn, formerly East Central district sales manager, now sales manager of the Cleveland district. **Carl T. Fuller,** formerly sales manager of the Southwestern district, now sales manager of the Chicago district. **Philip Mackay,** formerly sales representative in Philadelphia, now sales manager of the Philadelphia district. **George W. Overstreet,** formerly sales representative in the Eastern district, now sales manager of the

Never before such durable tank protection


Old way! Standard type alkyd primer made with conventional pigment particle
unusable reactive portion
Solid
New way! Defense in depth alkyd primer made with M50 pigment
Coated

Proof tank paints with M50® pigment form rust-inhibitive films of outstanding strength and durability



Test panels like these *prove* what paints can do. And these two make it plain that paints containing *M50* basic lead silico chromate — a new National Lead rust-inhibitive pigment ... form outstandingly strong and durable protective films.

Excepting the pigment, both primers shown on the test panels contain the same ingredients. Both are applied (2.0 mils, dry) on rusted and mill-scaled steel (to increase test's severity). Both have been exposed 12 months in industrial atmosphere (Perth Amboy, N. J.) and 12 months in normal atmosphere (Sayville, L. I.) at 45° South. You can see the effect.

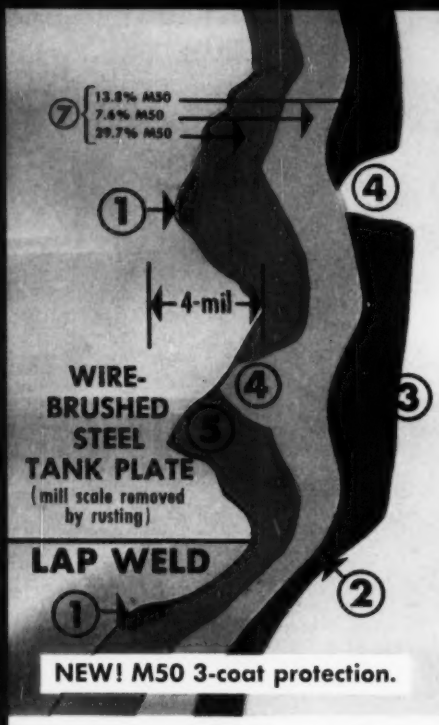
A striking difference! Yet film strengthening proves to be only one of many improvements that *M50* pigment makes in metal protective paints for steel tanks and structures. Now — with new *M50* pigment — your regular paint suppliers can provide metal protective paints with outstanding advantages:

- Weather-resistant anti-corrosive primers.
- Intermediate and finish paints *with* exceptional rust inhibition but *without* bilging hazard in sulfur-laden atmospheres.
- Finish paints in a wide range of decorative colors that don't fade or wash out.
- Alkyd-type conventional and heavy-coat paints with outstanding durability, package stability and sprayability.

What makes the difference? Basically the differences that make a difference in *M50* pigmented paints are inherent in the unique *M50* coated pigment particle itself (idealized particle shown above.) See, on the next page, the extra protections the *M50* particle provides in the dried film. See, too, how you can get the benefits of these new, much more durable, anti-corrosive paints.

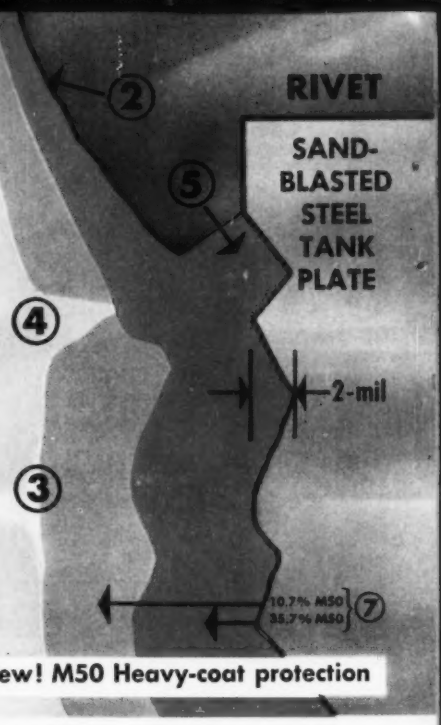
M50 pigment is a product of National Lead Company

General Offices: 111 Broadway • New York 6, N. Y.



NEW! M50 3-coat protection.

1. **Pockets of rust prove less harmful** on steel surfaces painted with conventional *M50* paints. Vehicles penetrate and isolate existing rust. *M50* particles stop rusting action.
2. **Where paint film lies thin** over tiny surface projections and sharp structural edges, the *rust-inhibitive* pigment content in all coats of *M50* paints provides extra protection.
3. **Just-right flow characteristics** of package-stable *M50* paints aid leveling on rough steel surfaces, promote smoothness, good appearance.
4. **Inevitable "holidays" in film** do not destroy protection. Again, *all M50* coats have both rust inhibition *and* weather resistance.
5. ***M50* paints "wet" well,** penetrate pits and crevices, carry *M50* protection to every part of these danger spots.
6. **Lightweight *M50* particle** aids formulation of new type heavy-coat paints with *uniform* rust inhibition throughout the film and low sag characteristics.
7. **Every coat can have rust inhibition** — not just the primer. Note percentages of *M50* in dry films. What's more, for equal weights of corrosion-inhibitive pigment, *M50* primers contain 40-60% more corrosion inhibition by volume than non-*M50* primers.



New! M50 Heavy-coat protection

Sections through M50 Defense in Depth films show dramatic extra protection these new tank paints provide

Information on the preceding page proves that *M50* pigment paints form stronger protective films than anti-corrosive paints made with other rust-inhibiting pigments. The sections above show some of the ways in which these new paints perform better in the dry film. Below you will see *proof* that *M50* metal protective paints don't bilge, are unique for color stability and the color range in which they can be made.

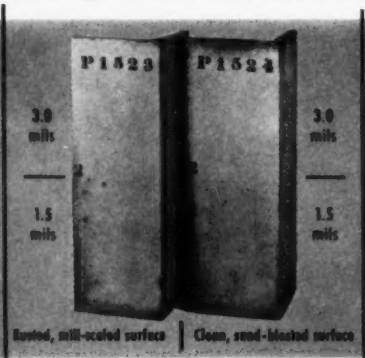
Hold the *M50* pigment particle itself responsible for all these improvements . . . *Basic lead chromate* is known for exceptional rust-inhibiting action. In the *M50* particle, this reactive business portion of the particle is coated on an inert core . . . where *all of it is available* to react. The coating is *fused* on—shows superior resistance to chalking, erosion, chemical action. Unusual tintability is due to the geometric configuration of the coated silica particle.

Why M50 Defense in Depth paints give anti-corrosion beyond all former concepts

2 standard pigment alkyd primer coats
2 M-50 pigment alkyd primer coats
Gray Alkyd Finish Coat
1 standard pigment alkyd primer coat
1 M-50 pigment alkyd primer coat

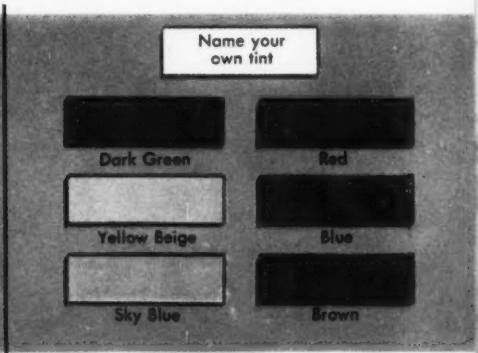
Exposed 9 years, 45°S. Each coat 1.5 mils

Proved corrosion and weather resistance



Exposed 4 years adjacent to refinery

Proved anti-bilging performance



Available in conventional and heavy-coat paints

Proved stability in wide range of colors

Are you concerned with tank or structure maintenance painting in your firm? If so, you are invited: (1) to visit National Lead's Sayville, L.I. test station, where you will see the results of the 20 years research that lies behind the *M50* pigment particle and the more than 10 years of exposure testing that lies behind *M50* pigment Defense in Depth paints; (2) to send coupon below for National Lead booklet, "Defense in Depth" and typical *M50* tank paint specifications.

Next time you purchase, specify *M50* pigment paints. Any paint manufacturer can supply you.

M50 Defense in Depth

National Lead Company,
111 Broadway, New York 6, N. Y.

Gentlemen: Please send me the "Defense in Depth" booklet together with typical tank paint formulas and color chips that I can use in specifying M50-type tank paints.

Name_____ Title_____

Firm or Dept._____

Address_____

City_____ State_____

Suppliers

Dallas district. **Edmund J. Campbell,** formerly sales manager of the Midwestern district, now sales manager of the Detroit district. **T. F. Vigmostad,** formerly sales representative in the Midwestern district, now sales manager of the St. Louis district. **Richard C. Cash,** formerly sales representative in the Southwestern district, now sales manager of the Birmingham district. **Fred F. Moore** will remain as sales manager of the New York district.

AMERICAN CYANAMID CO.'s Organic Chemicals division has appointed **Dr. T. F. Cooke** commercial development manager. He will coordinate technical service, market research and certain market development functions.

MINE SAFETY APPLIANCES CO.'s Technical Products division has named **Robert W. Swanson** sales engineer for the Detroit territory. An engineering graduate of George Washington University, he has been with the company since 1954.

CHEMETRON CORP. has acquired Cardox Corp.'s Carbon Dioxide, Chlorine Dioxide and Fire Equipment divisions. The three will be combined to form Cardox division of Chemetron, to be headed by **Roy T. Omundson,** former Cardox president.

Waples

McMullen

THE GARLOCK PACKING CO. has named **Robert M. Waples** chairman of the board. He has been the firm's president. **A. J. McMullen,** a vice president has been named president and principal executive and administrative officer of the company.

BECKMAN INSTRUMENTS, INC.'s Helipot division has named **Edmund A. Schreiber** purchasing agent. Before joining Beckman he was purchasing agent for Century Engineers. He studied business administration and engineering at Wittenburg College and the University of Colorado.

CONSOLIDATED ELECTRODYNAMICS CORP. has appointed **James P. LaBarber** manager of its New York district office. During the past year he was regional systems engineer for CEC in the East. Previously he was with Westinghouse Electric Corp.

U.S. STEEL CORP.'s Oil Well Supply division has appointed **William H. Combs** field representative at Casper. He has been with the company at Casper since 1953.

Two Austin-Western 5-ton hydraulic cranes work together as a precision team to handle delicate heat exchangers.

Twin Austin-Western hydraulic cranes form precision team at Cuban oil refinery

"Our first Austin-Western hydraulic crane performed its construction and maintenance duties so satisfactorily that we purchased a second a year later." That is what the manager of the Cuban refinery of a major American oil company says about the A-W 5-ton crane.

Easy to operate

"We have not lost any man-hours due to inadequate handling facilities for heavy materials . . . the A-W solves such problems before they can arise. The crane is so easy to operate that new operators can be trained in only 3 days or less. It would be encouraging to think that we could be as pleased with all future heavy machinery purchases as we have been with the Austin-Western cranes!"

The economical A-W hydraulic crane is a self-propelled, rubber-mounted unit with speeds up to 35 mph. Its basic 18-ft. telescoping boom rotates in a full circle. Choice of gas or diesel power. Maintenance requirements are low. Full hydraulic control makes precision handling of heavy materials safe and sure.

All-wheel drive and steer

All-wheel drive assures plenty of traction on any surface. All-wheel steering permits it to turn in less than its own length. It operates with amazing maneuverability in tightest quarters with low overhead clearances. Also available truck or stationary mounted.

Investigate. Learn now how this versatile hydraulic crane can speed your construction, maintenance and materials handling operations with added safety and profit. See your nearby Austin-Western distributor or write to us.

Austin 1859 AUSTIN WESTERN 1959 100th YEAR PARTNERS IN PROGRESS **Western**

CONSTRUCTION EQUIPMENT DIVISION, AURORA, ILL.

BALDWIN · LIMA · HAMILTON

BALDWIN BLH LIMA-HAMILTON

Power graders • Motor sweepers • Road rollers • Hydraulic cranes

For more data on advertised products, use Readers' Service Cards, last page.

Tailor-made, tough and chemically inert...

. . . these J-M Chempac Teflon components combat chemical and solvent action!*

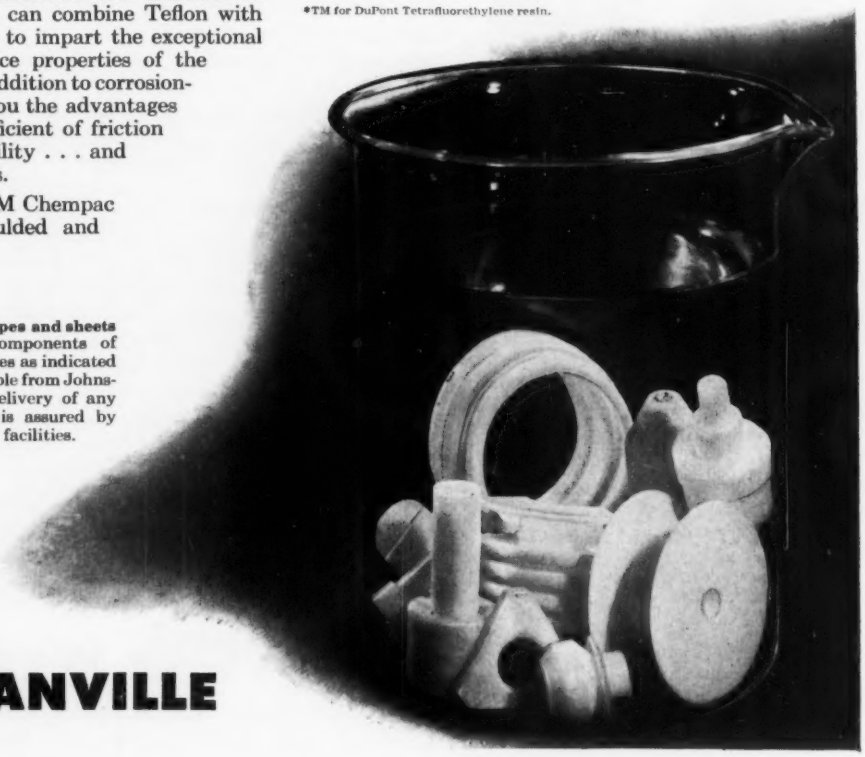
SMALL OR LARGE . . . intricate or simple . . . J-M Chempac® Teflon components have proved their exceptional resistance to the constant attack of corrosive chemicals in rugged service.

Look to J-M for Teflon packings, gaskets, and moulded shapes made to your exact specifications . . . or for parts that are machined to close dimensional tolerances. Moreover, we can combine Teflon with top quality J-M asbestos to impart the exceptional sealing and heat-resistance properties of the "magic mineral." And in addition to corrosion-resistance, Teflon gives you the advantages of an extremely low coefficient of friction . . . toughness and flexibility . . . and weight-saving possibilities.

You can also obtain J-M Chempac Teflon Packings in moulded and braided types for pumps and valves . . . in a wide range of flange and envelope-type gaskets . . . in rings, cups, sheets and tapes. Your J-M Packings Distributor can supply your needs. Or write Johns-Manville, Box 14, New York 16, New York. In Canada: Port Credit, Ontario.

*TM for DuPont Tetrafluorethylene resin.

Teflon rods, tubes, tapes and sheets —in addition to components of varied sizes and shapes as indicated here—are also available from Johns-Manville. Prompt delivery of any quantity you need is assured by new J-M production facilities.



JOHNS-MANVILLE JM PRODUCTS

JOHNS-MANVILLE

Tulsa operating-company officials of the Dresser Industries are shown completing final plans for their building at the International Petroleum Exposition grounds. The Exposition will be held in Tulsa May 14-23. Standing L to R, Don Curtis, Don Curtis Associates, Houston; D. L. McGill, advertising manager, The Guiberson Corp., Dallas; Steve Miranda, director of public relations and advertising, Dresser Industries, Inc., Dallas; and Ed Beauchamp, Jr., advertising manager, Lane-Wells Co., Houston. Seated are Pat Irwin, sales manager, Dresser Ideco Co., Columbus, Ohio and Walter Ender, design consultant, Dallas.

Suppliers

A. M. CUELLAR has opened an office in Bellaire, Texas, for supplying heat exchangers, pressure vessels and perforated trays to the oil industry. Cuellar was formerly with American Republics Corp., Gasoline Plant Construction and Tellepsen Construction companies. Most recently, he was with Nutter Engineering Co., Tulsa.

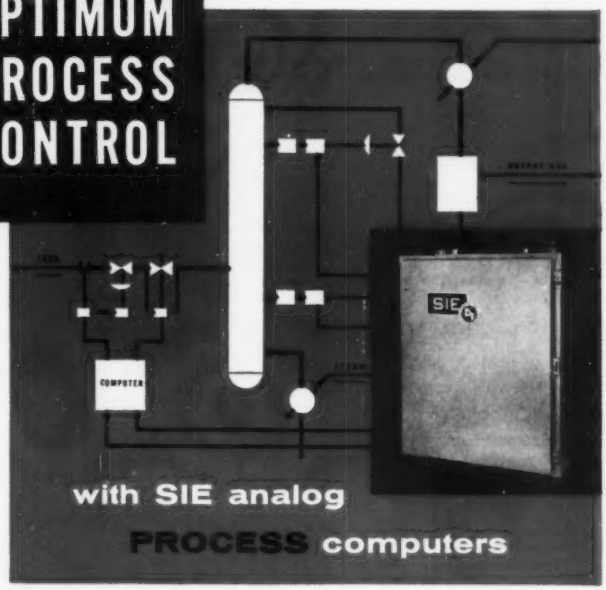
AVONDALE MARINE WAYS, INC., has been named a franchised applicator of U. S. Permobond tank linings by United States Rubber Co. Avondale will be the rubber company's outlet in Louisiana, Alabama, Arkansas, Mississippi and the western parts of Tennessee and Florida.

MINE SAFETY APPLIANCES CO., has named **H. Duke Edwards** sales engineer for the Philadelphia territory, Technical Products division. With the company since 1952, he is a graduate of Rutgers University.

DRESSER INDUSTRIES, INC.'s Roots-Connersville Blower division has established a new sales office in Los Angeles at 5120 Pacific Blvd. **H. W. Newsome** has been named to manage the office.

THOMPSON-RAMO-WOOLRIDGE CO. has appointed **Keith E. Curtice** to its technical staff. Formerly a computer operator at North American Aviation, Inc.'s

OPTIMUM PROCESS CONTROL



with SIE analog PROCESS computers

no ● moving parts
no ● vacuum tubes
no ● contacts

SIE CM-2 Analog Computers provide precise control in chemical, petrochemical, refining, and similar process applications, to a degree never before possible. Using this new concept, process variables are taken into account in adjusting set-points automatically to achieve optimum output yield.

Using Magnetic Amplifiers and Transistors CM-2 Series Computers have a **trouble-free life expectancy in excess of 100,000 hours,** yet in a typical fractionator application now in operation, computer cost was less than $5000.

Write for Brochure Describing Applications in Feed-Ahead, Feed-Back, and Operator Guidance computations. SIE engineers will welcome the opportunity to discuss the use of CM computers in your specialized process control applications.

SIE

SOUTHWESTERN INDUSTRIAL ELECTRONICS CO.
A Division of Dresser Industries, Inc.
2831 Post Oak Rd. • P. O. Box 13058 • Houston 19, Tex.

PRIME AND SUB-CONTRACTING FOR MILITARY ELECTRONICS INSTRUMENTATION AND GROUND SUPPORT EQUIPMENT

For more data on advertised products, use Readers' Service Cards, last page.

See why ALCOA ALUMINUM makes a good design habit

Requirement: Increase original service life of process equipment
Key to Good Design: Use Alcoa Aluminum to combat corrosion

Fighting corrosion is one of many ways aluminum can increase the original service life of your equipment. In major segments of the process industries, ALCOA® Aluminum is becoming the accepted standard for doing just this.

Chemical and petroleum plants find many uses for aluminum in their processes. Aluminum towers, driers and building products ward off atmospheric corrosion in seacoast locations, salt mines, and in similarly aggressive environments . . . areas where other metals fail. The electric power industry uses aluminum to resist the corrosive effects of soot, flyash, gases and vapors from the combustion of coal.

The food processing industry takes advantage of aluminum's other important features. Because it looks clean, is easily kept clean, and imparts no color or flavor to the product, aluminum is the best choice for pans, churns and vessels. These aluminum containers also have high heat conductivity . . . an important consideration where heat must be applied to the product.

The brewing and pharmaceutical industries use aluminum for still another reason. Here, process equipment must be nontoxic to micro-organisms. That's why aluminum pasteurizers and other equipment are specified for fermentation reactions in microbiological processes.

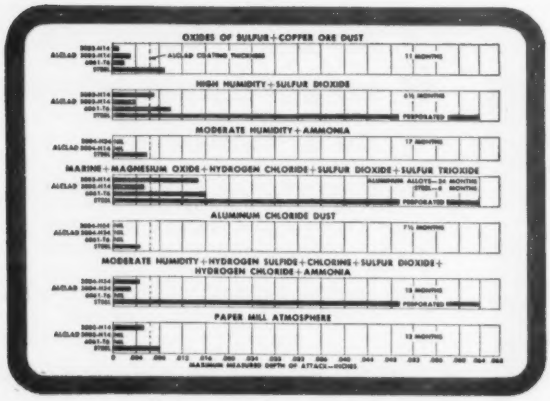
For other processes, aluminum's freedom from embrittlement at extremely low temperatures makes it particularly attractive. Good examples are the production of hydrogen, helium, oxygen, and various other cryogenic substances.

There's an area in your process where ALCOA Aluminum can help cut costs or improve efficiency. ALCOA can help you specify the alloy you need from the wide range available. Each offers specific advantages, and there is one certain to fit your requirements.

ALCOA engineers have worked closely with all segments of the process industries for over 40 years, and their unparalleled experience in this field is available to you for the asking. Write to the address on the coupon, stating your requirements as specifically as possible. ALCOA's development engineers will welcome the opportunity to work with you on your problems.

You also can take advantage of the wide selection of free ALCOA literature on aluminum for process equipment. Simply check the booklets you want on the coupon and mail to the address indicated. ALCOA will forward your material promptly and without obligation.

ALCOA is conducting a series of engineering conferences on process industries applications of aluminum during 1959 in a number of major cities. Contact your nearest ALCOA sales office for full particulars and dates.


OXIDES OF SULFUR + COPPER ORE DUST
HIGH HUMIDITY + SULFUR DIOXIDE
MODERATE HUMIDITY + AMMONIA
MARINE + MAGNESIUM OXIDE + HYDROGEN CHLORIDE + SULFUR DIOXIDE + SULFUR TRIOXIDE
ALUMINUM CHLORIDE DUST
MODERATE HUMIDITY + HYDROGEN SULFIDE + CHLORINE + SULFUR DIOXIDE + HYDROGEN CHLORIDE + AMMONIA
PAPER MILL ATMOSPHERE
MAXIMUM MEASURED DEPTH OF ATTACK—INCHES

Resistance of Alcoa Aluminum alloys to certain atmospheric contaminants, compared with steel.

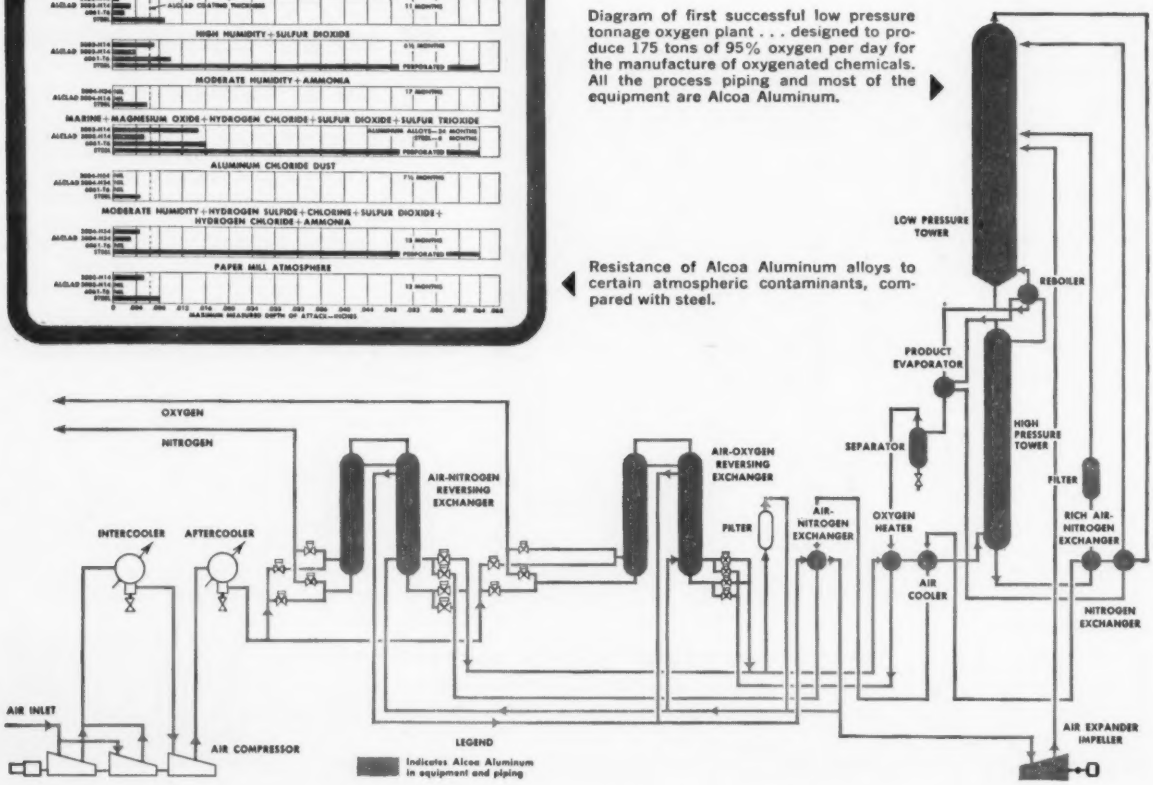
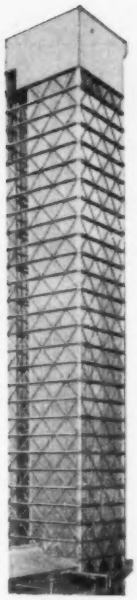


Diagram of first successful low pressure tonnage oxygen plant . . . designed to produce 175 tons of 95% oxygen per day for the manufacture of oxygenated chemicals. All the process piping and most of the equipment are Alcoa Aluminum.



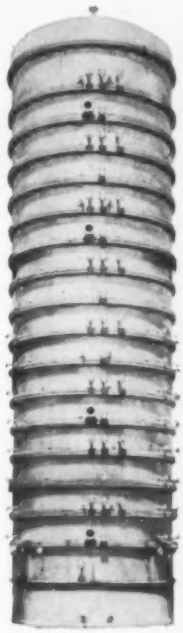
An aluminum prilling tower, 260 ft high by 40 ft square, used in the manufacture of solid ammonium nitrate. Auxiliary buildings are also covered with aluminum because of the corrosive atmospheres present.

Aluminum solidification pans and molds for solids such as stearic acid and waxes resist corrosion and do not discolor the product.

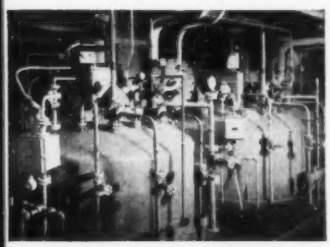
The naval stores industry uses aluminum to protect color and quality of rosin, rosin derivatives, turpentine and similar pine products.

Butter has little tendency to adhere to the cast aluminum surface of this churn.

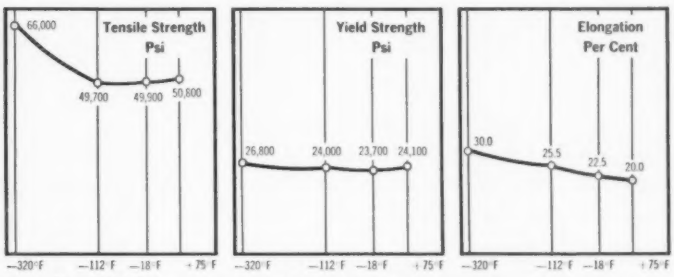
The sanitary appearance of aluminum covers and siding over these brewery pasteurizers is easily maintained.



Large scrubber tower for solvent recovery in a synthetic textile plant.



These 3,000-gal aluminum adsorption tanks are used in the production of antibiotics. Aluminum distribution systems for acetone and deionized water also are shown.



Alcoa Alloy 5456-O is used extensively in process equipment, especially for cryogenic applications. The graphs above show how this alloy's physical properties actually improve at low temperatures. At minus 320 degrees F it improves 30% in tensile strength, over 10% in yield strength and 50% in elongation.

ALCOA ALUMINUM
ALUMINUM COMPANY OF AMERICA

For exciting drama watch "ALCOA THEATRE," alternate Mondays, NBC-TV, and "ALCOA PRESENTS," every Tuesday, ABC-TV.

Aluminum Company of America
874-C Alcoa Building, Pittsburgh 19, Pa.

Please send me the following literature on Alcoa Aluminum applications in the process industries:

- ☐ GL866—Unfired Pressure Vessels of Aluminum Alloys
- ☐ GL149—Welded Aluminum Gas Cylinders, ICC approved
- ☐ 10197—Aluminum Pipe and Fittings
- ☐ 10186—Alcoa Aluminum Heat Exchanger Tubes
- ☐ 10270—Alcoa Utilitube
- ☐ 10460—Process Industries Applications of Alcoa Aluminum
- ☐ DD508—Aluminum Alloys in Tank Trucks and Tank Trailers
- ☐ 10387—Alcoa Standard Storage Tanks
- ☐ 20849—Resistance of Aluminum Alloys to Weathering and Resistance of Aluminum Alloys to Chemically Contaminated Atmospheres
- ☐ 20265—Have You Tried Aluminum in Your Refinery?
- ☐ GL93—Aluminum in the Pulp and Paper Industry
- ☐ 20272—Aluminum Alloys for Handling High Purity Water

Name_____

Company_____ Title_____

Address_____

City_____ State_____

For more data on advertised products, use Readers' Service Cards, last page.

Proved Procedure to cut costs by better Temperature control

Following is the gist of reports on scores of operations in a wide range of industries. Details on a specific application in your own line are available on request.

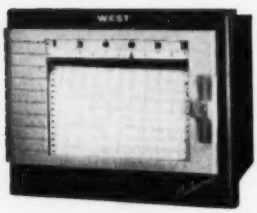
1. Chances are that temperature is a factor in at least one step of your operation. Effect of its control may range far beyond that one step.

2. Comparing virtually identical operations in different plants shows that degree of control varies widely. Even where control is considered "no problem," improvements invariably reduced costs in one or more steps.

3. Costs of operating the control equipment itself varies widely. Tubeless instruments, for example, avoid maintenance cost of adjustment and replacement of tubes and allied circuitry.

4. Greatest economies result from increasing quantity while maintaining quality of production. This is achieved by avoiding downtime or even delay due to control instruments or imperfect temperature of the material in process.

5. Best way to find out how much *you* can cut control costs is to call in a specialist who is familiar with most applications and free to propose just the right indicator, controller, recorder, etc. For free consultation many operators rely on world-wide service by West.



Marksman Recorders

Model M (shown) potentiometer strip-chart recorder delivers outstanding service and economy through features rarely available in a single instrument. Veri-Tell indicators and Gardsman controllers serve as well. All are tubeless, "solid-state" and proved in wide use. Phone your West consultant (see Yellow pages) or write Chicago office for Bulletin M or for COM digest-catalog of line.

WEST *Instrument*
CORPORATION
SALES OFFICES IN PRINCIPAL CITIES
FACTORY AND GENERAL OFFICES:
4363 W. MONTROSE, CHICAGO 41, ILL.
BRITISH SUBSIDIARY
WEST INSTRUMENT, LTD.
52 Regent St., Brighton 1, Sussex

the trend is to **WEST**

Suppliers

Missile division, he studied engineering and mathematics at the University of California. Also appointed was **Stuart T. Schy,** formerly with Librascope, Inc., Glendale, Calif.

T. D. WILLIAMSON, INC. has named **A. J. McNaughton** operations manager. A member of the American Society of Tool Engineers and the Tulsa Management Club, he was formerly assistant production manager for Century Electronics and Instruments, Inc. Before that he was plant superintendent for the Walter O'Bannon Co.

McNaughton

McNaughton attended Louisiana State and Tulsa Universities, and studied advanced mechanical engineering at Oklahoma State University while in the Army.

MINE SAFETY APPLIANCES CO.'s Technical Products division has named **Victor J. Elliott** sales engineer for the Newark, N. J., area. He has been with the company since 1951. Elliott graduated from Carnegie Institute of Technology.

THE SCAM INSTRUMENT CORP. has named **Roscoe H. Garrett** sales manager. A registered professional engineer, he was formerly with the Dynamic division of Eaton Manufacturing Corp. for 15 years as chief electrical engineer.

HOOKER CHEMICAL CORP. reports that researchers are moving into the new research center facing the west branch of the Niagara River at the north end of Grand Island, N. Y. Five minutes' drive from Hooker's Niagara Falls headquarters, the plant is on a 61-acre site.

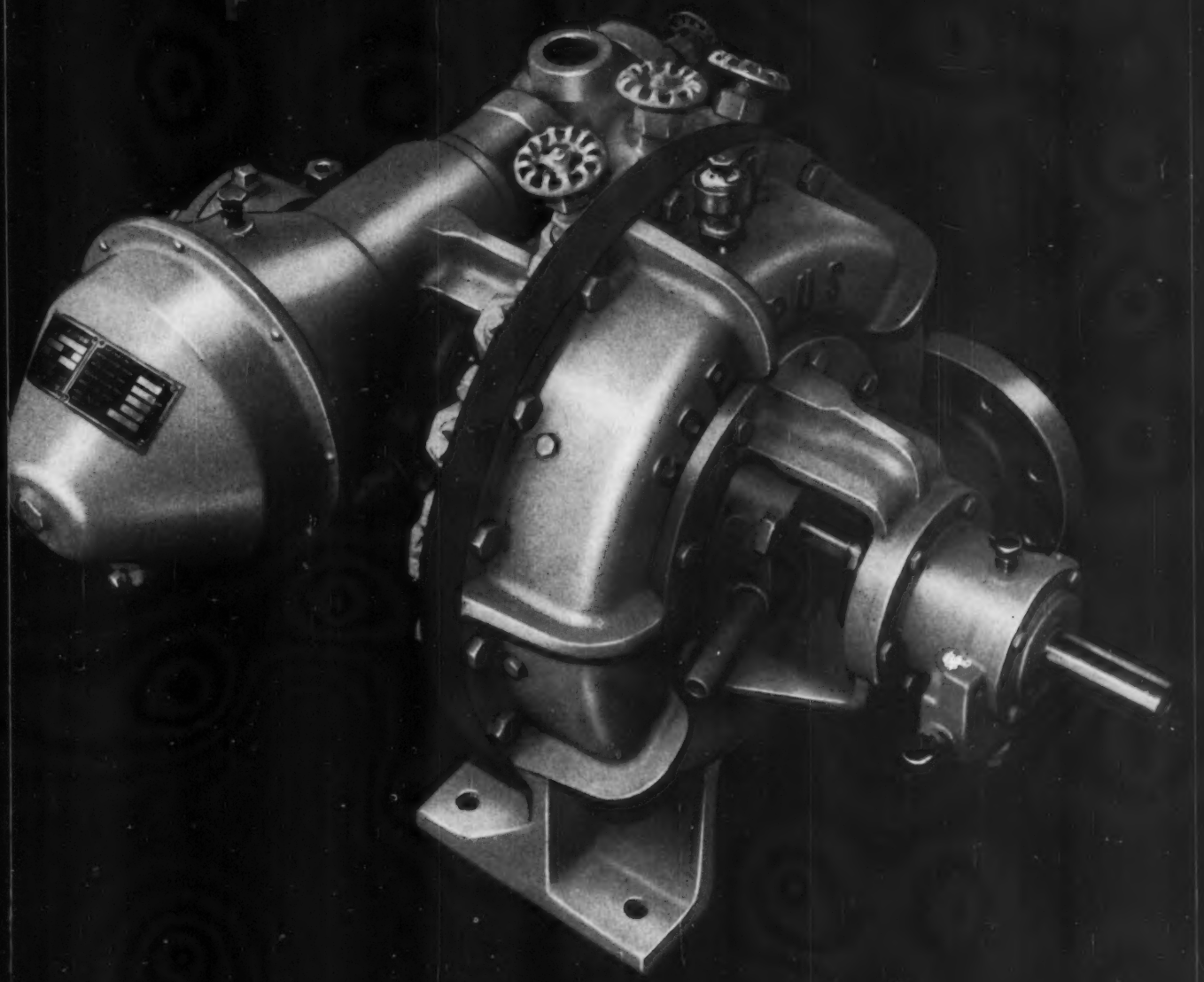
POLYMER CORP.'s Marketing division has appointed **J. T. Fitzgerald, S. C. Kilbank** and **T. L. Davies** area sales managers. **E. E. Gale** was named supervisor, technical services and **W. W. Winskill** supervisor, commercial services.

CONSOLIDATED ELECTRODYNAMIC CORP.'s Frederick W. Schaar has been named manager of the Orlando, Fla., district office. During the last year he has been a field engineer in CEC's Washington, D. C., district office.

INTERNATIONAL NICKEL CO.'s Nickel Refining division reported that **Ralph C. McGuire,** manager, died at the Port Colborne, Ont., hospital, December 23 of a heart attack. He had been with the company since 1929.

ALLIED CHEMICAL CORP.'s Barrett division has appointed **Edward Sullivan** and **Henry J. Reed** project engineers. Sullivan, a 1942 graduate of Michigan College of Mining and Technology joined

COPPUS BLUE RIBBON PRODUCTS



Coppus Horizontal Steam Turbine

NEW RUGGED DESIGN—BLUE RIBBON RELIABILITY! Here's a new dimension in turbine performance! Coppus brings you a new rugged stability of design . . . a new measure of reliability in a complete range of power-packed turbines, from 1 HP to 250 HP — marked with the Blue Ribbon only after each is precision made . . . precision tested. Performance features like these assure you Blue Ribbon Reliability —

A totally enclosed governor . . . totally enclosed, independently operated safety trip . . . easily replaceable packing and bearings . . . multiple steam nozzle control . . . brake rim for added safety . . . wide bucket "L" type wheel (optional) for minimum water rate.

Coppus Turbines are built to customers' specifications, including API and NEMA standards. All Coppus Products carry the same Blue Ribbon assurance of reliable performance. For further facts on turbines, send for new Catalog 200. COPPUS ENGINEERING CORPORATION, 416 Park Avenue, Worcester, Mass. Sales Offices in *Thomas' Register*.

COPPUS
STEAM TURBINES

Are Entrainment Losses Stealing Your Profits?

Centrifix®

SCRUBBERS • PURIFIERS • SEPARATORS

Increase Your Profits!

1. Increases efficiency of existing equipment—get *more* production PLUS valuable by-products that help pay for this improvement.

2. Removes 99.5% or more of ALL solid or liquid entrainment in gas, air, steam or vapor regardless of density, chemical characteristics or size (even 1 micron or smaller).

3. Protects valuable capital equipment from costly shutdowns and major overhaul.

4. Reduces maintenance cost—no moving parts, no filters, non-clogging, self-cleaning.

5. Operates with MINIMUM pressure drop regardless of pressure, temperature or flow rate.

6. Easy to install—saves space, low cost.

AA-8246

FOR THE FINEST IN PURIFYING EQUIPMENT FOR STEAM-VAPOR-GAS-AIR

Centrifix® CORPORATION

3608 PAYNE AVENUE

CLEVELAND 14, OHIO

All Centrifix equipment is protected by U. S. Letters Patent & Patents Pending

Suppliers

Barrett in 1957. Reed, previously with National Gypsum Co., has a mechanical engineering degree from Stevens Institute of Technology.

GENERAL ANALINE & FILM CORP. has elected **John Hilldring** chairman of the board. **Phillip M. Dinkins,** who has been general manager and vice president of the Dyestuff and Chemical division, was elected president.

YUBA CONSOLIDATED INDUSTRIES, INC. has purchased Southwest Welding and Manufacturing Co., Alhambra, Calif. Southwest will operate as a subsidiary of Yuba, and John Lucas will remain active in its management.

CRESCENT INSULATED WIRE & CABLE CO. has appointed **Berry-Elsberry Co.** its representative in Georgia, Alabama, Eastern Tennessee and Western Florida. **Robert W. Fishburne Co.** will represent Crescent in the South Carolina territory.

THE PFAUDLER CO. has named **Cloyd L. Betzer** technical manager. He will be responsible for all Pfaudler engineering, research and development activities except production and industrial engineering. He will continue as chairman of the development coordinating board and become a member of the management committee. Betzer joined Pfaudler in 1957 as a member of the staff of the vice president in charge of manufacturing.

Betzer

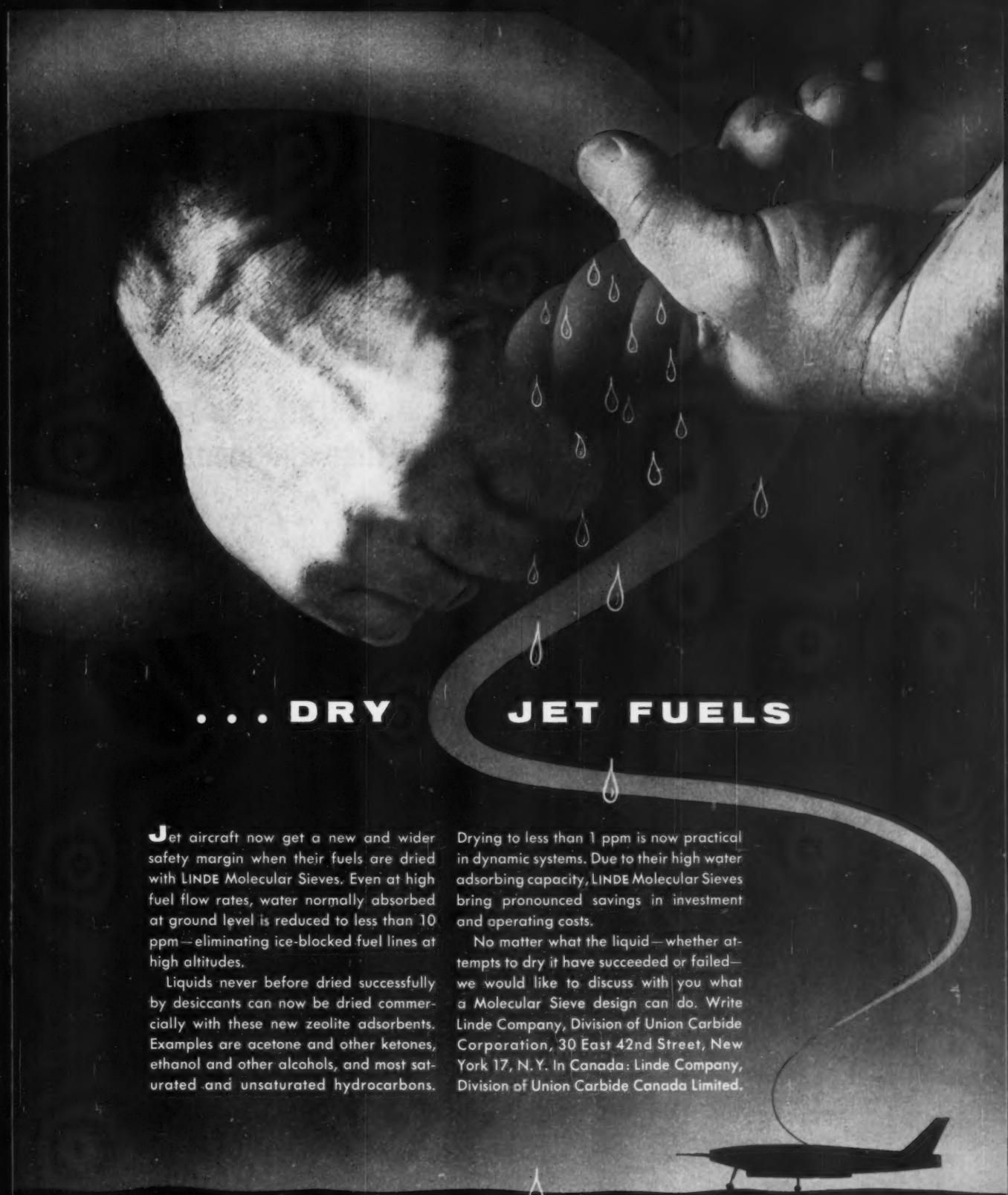
ARMCO STEEL CORP.'s Sheffield division, Houston, has completed facilities for high-strength, heat-treated alloy steel. The move reportedly makes Houston the only Southwest producer of such steel.

FOOD MACHINERY AND CHEMICAL CORP.'s Becco Chemical division has assigned **J. Miller Byne III** to its Southern sales territory. A graduate of Davidson College, he was previously in the U.S. Army.

ETHYL CORP. has named **Leonard L. Huxtable** manager of the Western Region, Sales department. He joined Ethyl in 1932 and has spent his entire career in sales throughout the Midwest and Southwest.

PFAUDLER PERMUTIT, INC. has elected **Mercer Brugler** chairman of the board, **Donald A. Gaudion** president and **C. Wendell Beck** manager of the Pfaudler division. Brugler will also continue as chairman of the executive committee.

THE B. F. GOODRICH CO. has elected **William W. Scull** vice president, manufacturing. A mechanical engineering graduate of Cornell University, he will



. . . DRY JET FUELS

Jet aircraft now get a new and wider safety margin when their fuels are dried with LINDE Molecular Sieves. Even at high fuel flow rates, water normally absorbed at ground level is reduced to less than 10 ppm—eliminating ice-blocked fuel lines at high altitudes.

Liquids never before dried successfully by desiccants can now be dried commercially with these new zeolite adsorbents. Examples are acetone and other ketones, ethanol and other alcohols, and most saturated and unsaturated hydrocarbons. Drying to less than 1 ppm is now practical in dynamic systems. Due to their high water adsorbing capacity, LINDE Molecular Sieves bring pronounced savings in investment and operating costs.

No matter what the liquid—whether attempts to dry it have succeeded or failed—we would like to discuss with you what a Molecular Sieve design can do. Write Linde Company, Division of Union Carbide Corporation, 30 East 42nd Street, New York 17, N.Y. In Canada: Linde Company, Division of Union Carbide Canada Limited.

Linde UNION CARBIDE

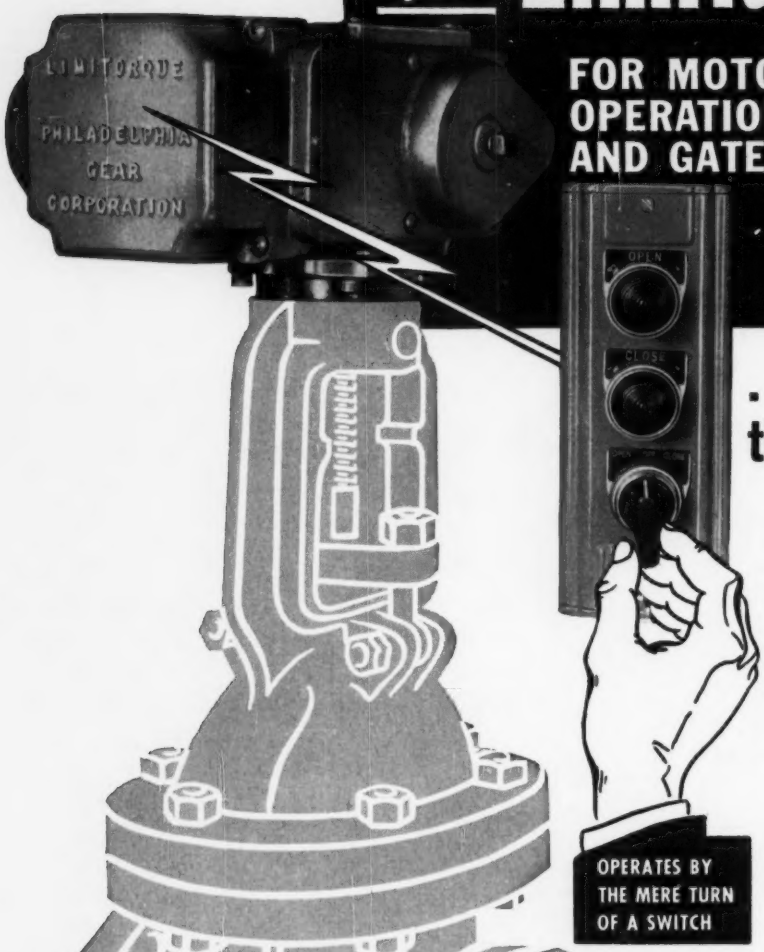
"Linde" and "Union Carbide" are registered trade marks of Union Carbide Corporation.

New LimiTorque

TYPE P-2

FOR MOTORIZED AUTOMATIC OPERATION OF SMALL GLOBE AND GATE VALVES

. . . Economically and Efficiently



. . . truly a dependable time and money saver

Here is a new, compact, economical and dependable LimiTorque Motorized Operator for use on small (normally hand-operated) Globe and Gate Valves — either new or already in service. Your existing hand-operated valves can now be easily motorized by the removal of the hand-wheel, and mounting the P-2 Unit on the same bonnet . . . the Unit output drive sleeve will then drive the hand-wheel unit, which arrangement is suitable for both rising and non-rising stem valves.

The P-2 LimiTorque Operator has a standard out-put speed of 22.5 or 45 rpm, which covers the average and recommended operating speed for most Globe and Gate Valves.

Remember, this new P-2 LimiTorque is built by the largest manufacturer of Motor Operators for Valves in the World . . . backed by nearly 30 years experience.

BE CONVINCED how the P-2 can save you time, labor and money in the operation of small valves — just write for Bulletin No. 21-58, which not only illustrates and explains its operation, but shows how easily it can be installed on existing or new valves.

Contact your Valve Manufacturer, or your nearest LimiTorque Sales Engineering Office.

Use your Business Letterhead when sending for special Bulletin 21-58

EASILY INSTALLED ON NEW OR EXISTING VALVES

"Motorize to Economize"

THERE IS NO SUBSTITUTE FOR —

LimiTorque®

PHILADELPHIA GEAR CORPORATION

ERIE AVE. & G STREET, PHILADELPHIA 34, PENNA.

Offices in all Principal Cities

INDUSTRIAL GEARS & SPEED REDUCERS • LIMITORQUE VALVE CONTROLS • FLUID AGITATORS • FLEXIBLE COUPLINGS

Limitorque Corporation • Philadelphia

For more data on advertised products, use Readers' Service Cards, last page.

Suppliers

be responsible for purchasing, traffic, raw materials planning, design and construction, machine development, time study and methods, industrial engineering and safety.

A. O. SMITH CORP. has named **Archie C. Anderson** technical director of the Reinforced Plastics division. Prior to his new appointment, he headed A. O. Smith's Reinforced Plastics Development laboratory. He previously had been with Young Development Laboratories. Anderson received a B.S. degree in engineering from the University of Toronto, and is a member of the Society of the Plastics Industry, NACE, and ASA.

Anderson

E. I. DUPONT DE NEMOURS & CO., INC. has named **Arthur E. Bowe** laboratory manager and **Frederick B. Stehr** promotion coordinator in the Chemicals division, Western region. Bowe has been with the division since 1947 and Stehr since 1951.

ALAN WOOD STEEL CO. has named **Dr. Arthur B. Backensto, Jr.,** research metallurgist. He will direct research toward increased use of iron powder. Alan Wood is currently building a $3.6-million plant to produce iron powder.

MINE SAFETY APPLIANCES CO.'s Technical Products division has named **William J. Young** sales engineer for the Houston territory. An engineering graduate of Rice Institute, he has been with the company since May, 1957.

DEAN BROTHERS PUMPS, INC., has named **Noble Dean, Jr.,** president of the firm. He has held executive positions with the company since 1950 and has been vice president and general manager since 1955.

WALWORTH CO. has named **Harold Brown** general sales manager. He joined the company in 1958 as assistant manager of technical sales service, having previously been with Metallurgical Associates, Inc.

ALLIED CHEMICAL CORP.'s Solvay Process division has named **Loy R. Whiteside** manager, Chicago sales branch. He joined the Chicago office in 1937, and became a salesman in 1946. Whiteside will supervise sales in several states.

T. D. WILLIAMSON, INC. has opened a branch office in Houston and placed a factory representative in Monroe, La. The new office will service Gulf Coast refineries and chemical plants. **H. A. Lister** will be Houston district manager and **Jerry Johnson** will be Monroe representative.

MOST COMPLETE LINE

Eleven Product Groups Serve Every Sealing Need

GROUP NO. 7

Sheet Packings

Forty-two styles of superior Sheet Packings are offered in the Belmont Line.

Unmatched variety of constructions—to suit every sheet packing requirement in service against steam, oil, solvents, corrosive chemicals and extremes of temperature—includes compressed asbestos, woven asbestos metallic, "Petrola" fibre, cork, red rubber, natural rubber, G.R.S., Neoprene, Buna-N, Silicone, Diaphragm sheet and Teflon*.

Cut gaskets are also available from all of these materials.

See your Belmont Distributor, or write for name of one nearest you.

OTHER BELMONT PRODUCT GROUPS

1. High Pressure Asbestos Packings
2. Valve Stem Packings
3. Rotary Pump Packings & Seals
4. Criss-Cross Braided Packings
5. Hydraulic Packings
6. Bel-Vee V-Rings
8. Gaskets
9. Metallic Packings
10. Plastic Packings
11. Expansion Joints

MOST CONVENIENTLY AVAILABLE

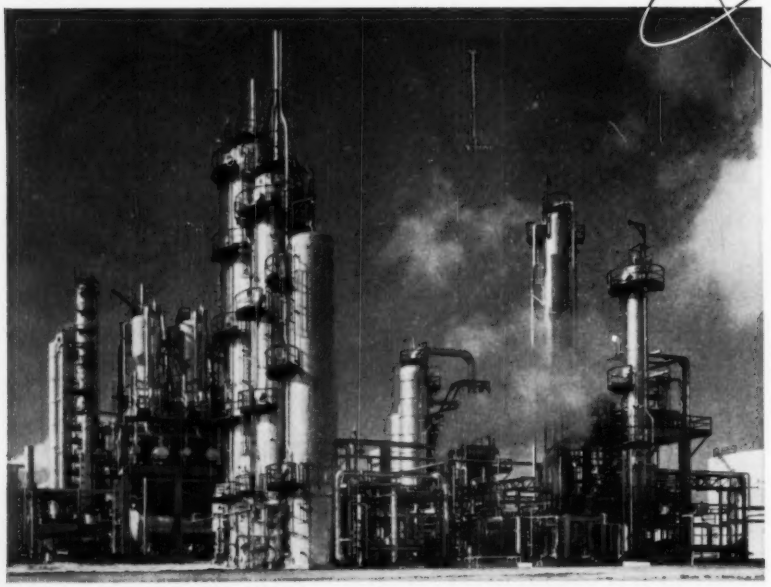
Nationwide Industrial Distributor Organization Provides On-the-Spot Service

*du Pont Trademark

BELMONT

The Belmont Packing and Rubber Company
Butler & Sepviva Streets, Phila. 37, Pa.

Photos by Robert Yarnall Richie



Designed, engineered and constructed by The Lummus Company, this giant petrochemical complex at Lake Charles, La., has three separate control rooms. The compressor and boiler unit is controlled by 38 Microsen control loops. 141 other loops measure variables to control ethylene processing, and 75 more control the ethylene oxide-glycol unit. Kybernetes data read-out equipment is integrated with Microsen instruments in one of the control rooms.

For more data on advertised products, use Readers' Service Cards, last page.

Over 250 Microsen® loops

automate processes at

Petroleum Chemicals, Inc.

and Calcasieu Chemical Corp.

Microsen Electronic Process Instrumentation measures and controls temperature, pressure, flow, and liquid level in this new $80,000,000 installation. Microsen, the DC control system pioneered by Manning, Maxwell & Moore, Inc., was selected for quality of control and ease of installation.

Standard Microsen instruments are used in cascading. By adding ratio amplification in the output of master Controllers, special variable cascade units are created.

The process boiler installation is unique in the use of electronic instrumentation to control both air and gas supply. A special bipolar accelerating amplifier provides zero output under stable process conditions for the three-element feed-water boiler controls.

If a process upset occurs, the amplifier increases output in the indicated direction to correct the deviation. Amplifier output then decays to zero. Decay time is continuously adjustable within a range of .05 to 5.0 seconds.

Field wiring from Transmitters and Valve Positioners is carried in explosion-proof conduit which terminates in ducts at the rear of the panels in each control room. Wiring from ducts to panel instruments is covered with flexible rubber.

Microsen Electronic Process Controls assure permanent savings. They instantly transmit accurate measurements over long distances – assure process stability and efficiency. The DC signal (1.0 to 5.0 ma) is compatible with practically all data handling, telemetering and computing systems, and with process stream analyzers being developed. Microsen design flexibility anticipates ever-changing needs in process control.

Be certain of closer process control. Step up product quality and quantity. For new plant, new process or revamped old process, automate with the Microsen Electronic System. Learn how profitable it can be. Write for information or call in one of our sales engineers.

MANNING MAXWELL & MOORE INC. M&M TRADE MARK

MICROSEN ELECTRONIC CONTROLS

A product of

MANNING, MAXWELL & MOORE, INC.

Consolidated Ashcroft Hancock Division • Stratford, Connecticut
In Canada: Manning, Maxwell & Moore of Canada, Ltd., Galt, Ontario

For more data on advertised products, use Readers' Service Cards, last page.

Petroleum Refiner Classified Ads

Petroleum Refiner New Classified Rates

RATES: Regular Classified (undisplayed) set in this type: 20 cents per word. Minimum charge, $4. Blind box address in our care counts six words. Replies forwarded without charge. **Display Classified ads,** set in suitably larger type with ruled border, $12.50 per column inch. Ten percent discount for two or more insertions of same copy in consecutive issues. **All Classified ads payable in advance.** Copy deadline: 25th of month preceding date of issue. Send copy and checks to: Classified Advertising, Petroleum Refiner, P. O. Box 2608, Houston, Texas.

* * * * * * * * * * * * * * * * *

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Tanks, Sewers, Stacks, Floors
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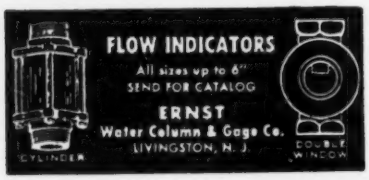
When you see a large chimney think of Sauereisen Cements.



■ Sales: Engineered Equipment To Refining and Petrochemical Industry. Technical background. Established 20 years Tulsa. Expansion Oklahoma, southern Kansas, Texas Panhandle proposed. Answer Box 307-R, PETROLEUM REFINER, Houston, Texas.

■ CLEANING EQUIPMENT—for plant maintenance and tank cleaning. Hot "jet-stream" cleaning with Sellers Hydraulic Jets. Send for Bulletin 424-B Sellers Injector Corp., 1603-L Hamilton Street, Philadelphia 30, Pa.

SITUATION WANTED

CHEMICAL ENGINEER: Ph.D.: Nine years experience as plant and process engineer in refinery and petrochemicals. Solved variety of problems in platinum reforming, isomerization, distillation, and waste disposal. Designed plants were highly successful. Publications, patents, and broad contacts. Age 39. Family. Box 313-R, PETROLEUM REFINER, Houston, Texas.

Chemical Engineer—29, single, M.S. 5 years oil refining experience both overseas and U.S. Process design and evaluation, economic studies technical service. Knowledge and experience in foreign operations and contacts. Desires permanent position where technical and special background experience can be fully utilized. Location preferably metropolitan New York. Box 311-R, PETROLEUM REFINER, Houston, Texas.

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PETROLEUM REFINERY CHEMICAL ENGINEERS APPLIED MATHEMATICIANS

For expanding technical activity engaged in consulting-type service to petroleum refiners. Positions involve a wide variety of projects in sales, research, refining, and company management. Excellent opportunities for persons with either or both of the following backgrounds:

A few years of refining industry experience in process engineering or economic analysis.

Experience in applications of linear programming, statistics, or electronic computing.

These positions afford professional contact with refining and process companies throughout the petroleum industry, and provide opportunity for using initiative and individual expression to increase responsibility. Detroit suburban location.

Send resume to:

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1600 W. 8 Mile Road — Ferndale 20, Michigan

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Our newly organized Technical Service Department has openings in our Port Arthur, Texas Refinery for Engineers with up to 5 years' experience in the refining or chemical industry. Send resume giving full details of education and experience, as well as salary requirements to:

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Well-established successful firm has opening in an expanding sales department for young man looking for an opportunity in sales work. Must be college graduate, not over 33, in good health and not afraid of work. Oil industry experience desirable. Applicant will be trained at home office before moving into sales work on basis of salary plus commission incentive and traveling expenses. Our own sales personnel know of this advertisement. Your reply will be confidential and should be sufficiently complete to merit contacting you for an interview. Address Box 312-R, PETROLEUM REFINER, Houston, Texas.

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■ PETROLEUM REFINER back issues and files wanted to buy for cash, also other technical journals. P. R. Ashley, 27 East 21, New York 10, N. Y.

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Application of instrumentation and automation techniques to all phases of petroleum industry operation. Opportunity for travel as consultants as on new techniques and equipment application. Experience in instrumentation field required.

Give full details of education, experience, desired salary and references. All inquiries will be considered promptly and held confidential.

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With these 3 RIDGID®

Jam-Proof Pipe Threaders

my power drive threading is Safe...

. . . no watching to keep them from jamming
. . . save me a lot of time, too!

1" to 2" Pipe RIDGID 65R-TC

Jam-proof—can't jam if you forget it . . . Threads 4 sizes of pipe and conduit with 1 set of dies . . . True-Centering workholder—no more crooked threads—but adjustable for drip threads. Far more for your money—compare!

2½" to 4" Pipe RIDGID 4PJ

Jam-proof . . . drive pinion kicks out automatically—real safety when power threading. Workholder sets to size before putting on pipe. Other exclusive advantages. Special 4PJ for conduit.

4" to 6" Pipe . . . RIDGID 161

Jam-proof for safe power threading. 1 set of dies threads 4", 4½", 5" and 6" pipe and conduit—sets to size fast. Workholder sets to size before putting on pipe, a work-saver feature. Many other reasons why the 161 is your best buy!

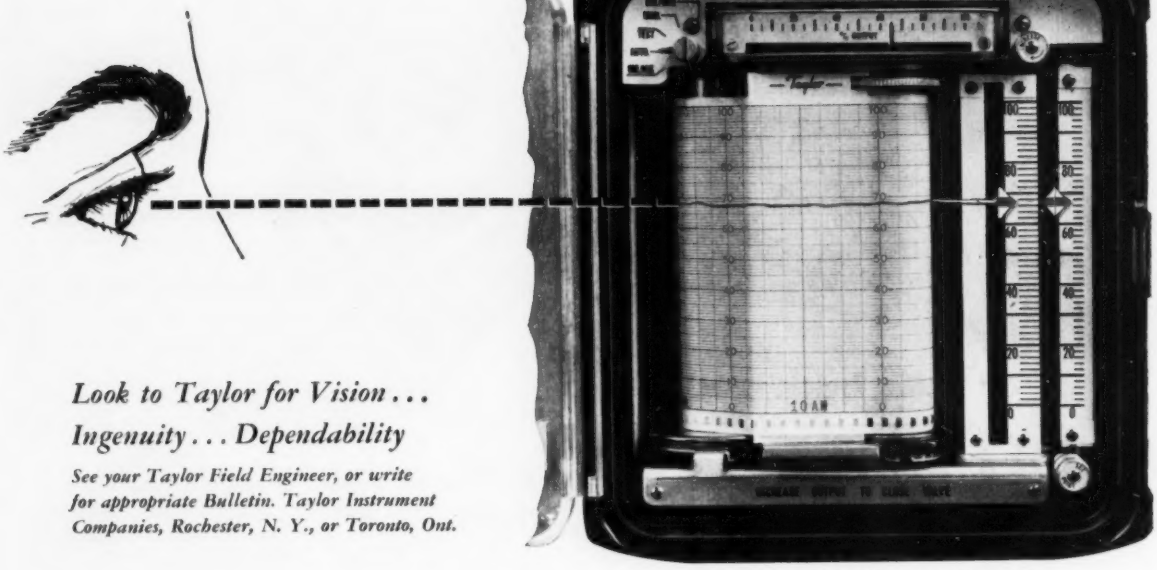
See and try these popular RIDGID Threaders . . . at your Supply House.

THREADED PIPE . . . *It's Tight . . . It's Best . . . Costs Less!*

For more data on advertised products use Readers' Service Cards, last page.

UNCONFUSED

in both Electronic and Pneumatic

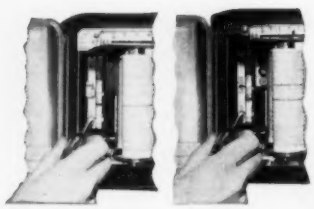


Look to Taylor for Vision . . .
Ingenuity . . . Dependability

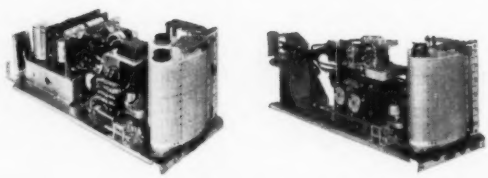
See your Taylor Field Engineer, or write for appropriate Bulletin. Taylor Instrument Companies, Rochester, N. Y., or Toronto, Ont.

701J AC or DC Electronic Recorder

Compare these features . . . common to the 701J Electronic



1. A Taylor 'first'. On both Electronic (left) and Pneumatic (right) instruments, controller response adjustments are quickly and easily made from the front, where results can be watched. You can visualize immediately all pertinent process information — chart, pen and set-point.



2. All major components plug in. Even individual amplifier circuits plug in. You can service all components and still stay on control. AC and DC Recorders are completely transistorized; unaffected by a supply voltage change up to ±10%.

Taylor Instruments

READABILITY

instrumentation by Taylor

• **Simplest scanning of all** . . . because chart record, pen and set-point are side-by-side,

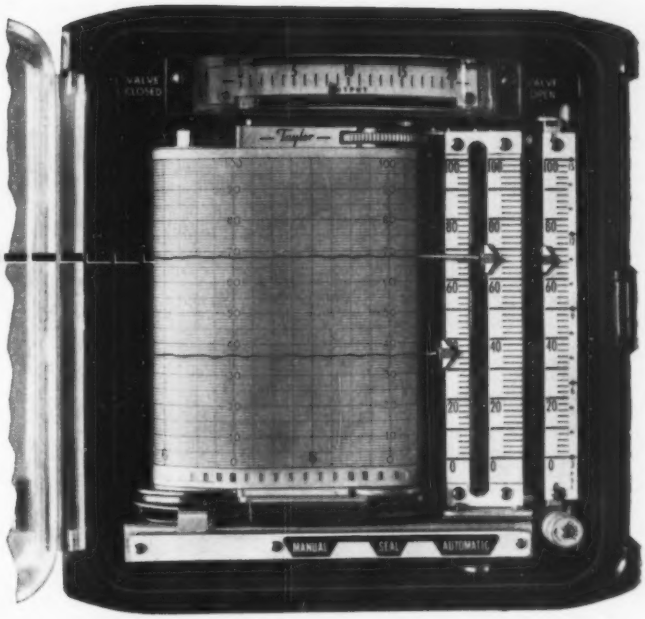
• **Invites frequent reading** . . . because target-type pens and pointers are easiest of all to see, even at a distance.

• **Operators make fewer mistakes** . . . because all pertinent data is lined up.

• **You read the 4″ chart** from left to right—like a newspaper—on rectilinear coordinates.

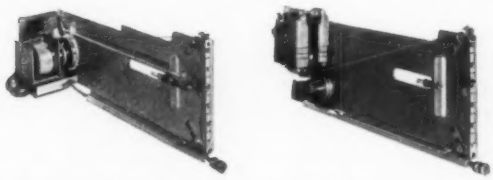
• **All these features** in a 6″ x 6″ cutout.

*Reg. U.S. Pat. Off.

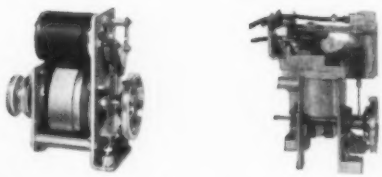


90J TRANSCOPE Pneumatic Recorder*

AC or DC Recorder and the 90J TRANSCOPE Pneumatic Recorder



3. Plug-in Set Point Transmitters, parallel to and exactly matching chart range, permit comparison without confusion and accurate adjustment of the control point. They can be removed for checking with only momentary interruption of record.



4. Powerful Servo Motors give more precise pen positioning than ever before. More accurate records. Unmatched threshold sensitivity. Unparalleled power permits use of process alarms, new inking system and elimination of flimsy linkage.

MEAN ACCURACY FIRST

For more data on advertised products, use Readers' Service Cards, last page.

Analyzer Keeps Process Stream Pure

At Pennsalt Chemicals Corp.'s Calvert City, Ky., Isotron plant, a new gas chromatography analyzer provides a reading every ten minutes to guide operators to efficient, accurate processing of refrigerants and aerosol propellants. Extremely high purity products are thus produced, which is important because of the increasing use of aerosols in the food and drug industries.

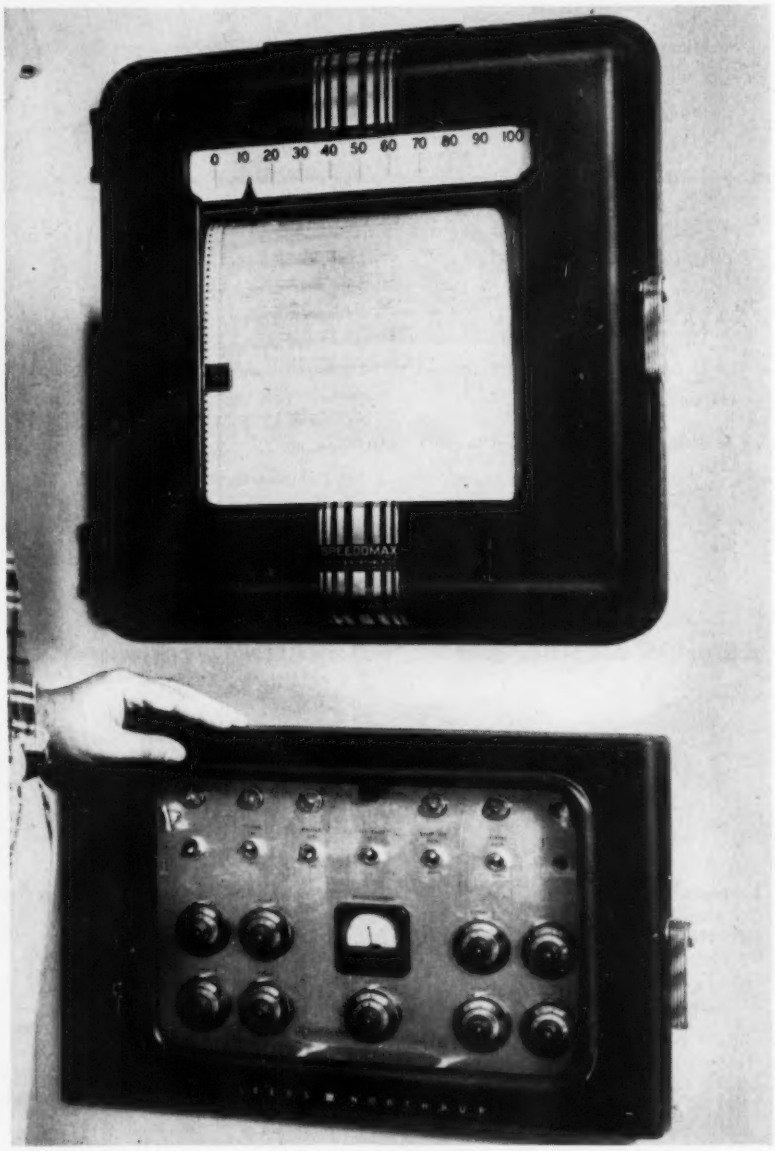
For more than six months, the analyzer has helped Pennsalt engineers reduce impurities in these products. Connected directly to the process stream only a few feet away from the control room, this analyzer provides up-to-the-minute data on purity. Impurity levels as low as 0.01 percent are thus detected.

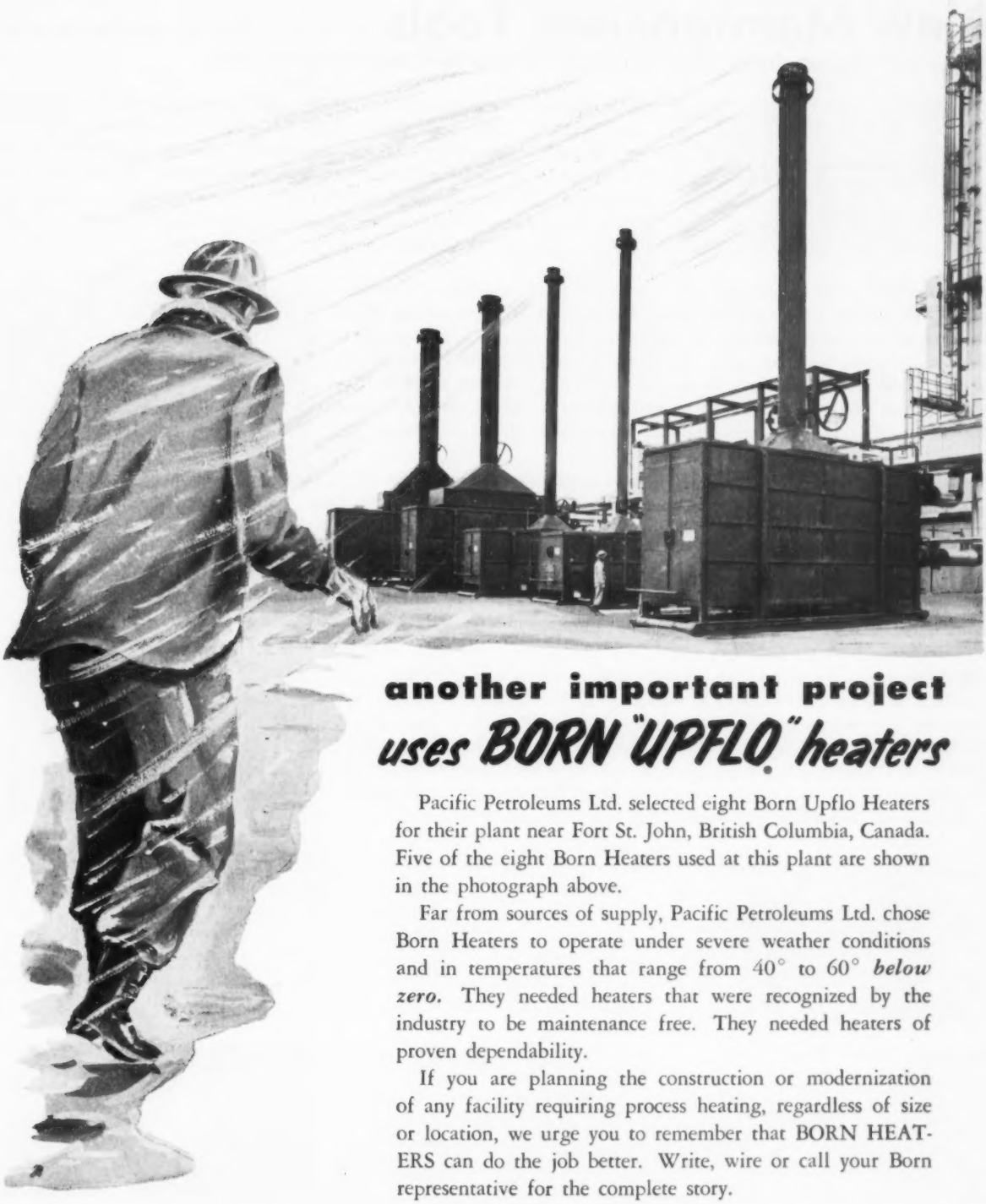
Pioneering in the use of chromatography for component analysis, Pennsalt found that the data from the Chromomax instrument enables their operators to reset control points with confidence to consistently produce a product that is better than 99 percent pure. Confidence in the analyzer data is based on a close comparison, made during the first few months of operation, with a conventional laboratory chromatography analyzer. Analyses checked so closely that no discernible difference could be noted. Now, they simply check the analyzer against a standard sample once a week.

The Chromomax analyzer consists of three units; a programmer, recorder and analyzer. The recorder, a Speedomax stripchart instrument, has a scale graduated from 0 to 100 and can either draw a bar record or a spectrum of the results of the analysis. Functioning of the unit is controlled by the programmer which admits sample streams, advances the detector output through continuously adjustable attenuators, and advances the recorder chart 1/10-inch between components, and any desired distance between streams.

As with any new instrument, Pennsalt's maintenance group was concerned about the possibilities of excess maintenance on this instrument. They found that the only requirements were routine jobs, such as renewing chart paper and ink and changing gas cylinders. They also found that after process changeover, new programing cycles were quick and easy to set up, thus speeding startups. Leeds & Northrup Co.

Circle E1 green card, last page





another important project
uses BORN "UPFLO" heaters

Pacific Petroleums Ltd. selected eight Born Upflo Heaters for their plant near Fort St. John, British Columbia, Canada. Five of the eight Born Heaters used at this plant are shown in the photograph above.

Far from sources of supply, Pacific Petroleums Ltd. chose Born Heaters to operate under severe weather conditions and in temperatures that range from 40° to 60° ***below zero.*** They needed heaters that were recognized by the industry to be maintenance free. They needed heaters of proven dependability.

If you are planning the construction or modernization of any facility requiring process heating, regardless of size or location, we urge you to remember that BORN HEATERS can do the job better. Write, wire or call your Born representative for the complete story.

BORN Engineering Company

Manufacturers of Direct-Fired "UPFLO" Heaters

TULSA, OKLAHOMA

BRANCH OFFICES:
Denver, Colorado; Houston, Texas; Los Angeles, California; New York, New York; Shreveport, Louisiana

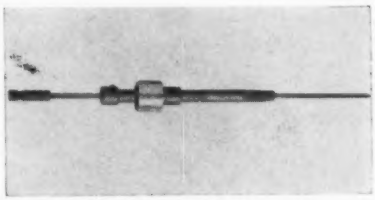
IN CANADA:
Canadian Brown Steel Tank Co., Ltd. Brandon, Manitoba, Canada

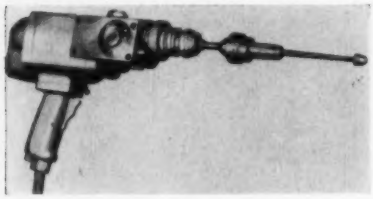
For more data on advertised products, use Readers' Service Cards, last page.

New Maintenance Tools . . . These maintenance tools, introduced during the last year, lead to low maintenance costs

Air Scaler allows the use of the broadest possible range of chisels for one single tool. **Cleco Air Tools,** a division of Reed Roller Bit Co., has incorporated a new design into this tool, used for general scaling, beading and peening. Both "push throttle" and "lever throttle" controls are available. The tool noses are replaceable. The rugged scaler barrels are interchangeable with two models, facilitating stocking of parts. Also, additional utility and convenience result from backhead interchangeability. (E2)

Tube Rolling in thick tube sheets is no longer a problem. **Elliott Co.**'s "protractive-retractive" tube expander rolls tubes in thick sheets, traveling either forward or backward to achieve an even, continuous expansion job. It uses a continuous rolling method which eliminates the annular space left by partial rolling; produces a uniform tightness between tube and tube sheet for the entire length of the rolled portion; and produces a smooth, uniform, rolled interior surface that eliminates chances of corrosion. (E3)



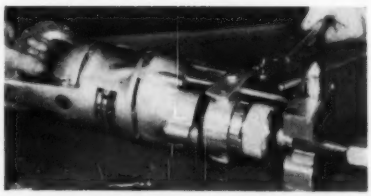


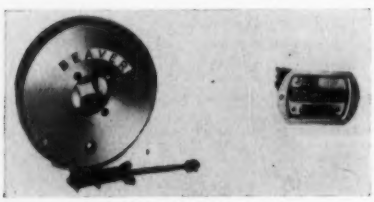
Tube Expander Drives designed by **Thomas C. Wilson, Inc.** for tubes up to 1½ inches O.D. The Torq-Air-Matic was designed expressly for use on exchanger tubes in petroleum processing plant service. The new model B is available in three versions, ranging from 38 to 22 ft. lbs. torque and from 450 to 750 rpm. A companion model C in one size, 75 ft. lbs. torque and 200 rpm, is designed for tubes used in boilers, reboiler or waste heat boilers, ammonia condensers, sulphite evaporators, air preheaters, etc. (E4)

Air Gun is a unique, de-rusting, cleaning and descaling tool that cleans and de-scales practically all surfaces by means of a set of rapidly reciprocating, hardened steel needles pounding the surface being worked. This gun is made by **The Marindus Co.** and is called the Von Arx air gun. One of the unique features is the ability of the gun to clean and de-scale irregular surfaces. It operates on normal air pressure, not more than 90 psi and consumes air at a maximum of only 13 cu. ft. per min. (E5)

Condenser Cleaning Tool provides extremely fast and effective cleaning of condenser tubes. The tool, made by **Crane Packing Co.,** utilizes a gun-and-slug method to thoroughly remove slime and scale at a considerable time savings over ordinary mechanical methods. The gun weighs only 2¾ pounds—can be used by an operator for lengthy periods of time without fatigue. Three types of slugs for normal slime, heavy slime and scale or mineral deposits are available to fit all standard tubes. (E6)

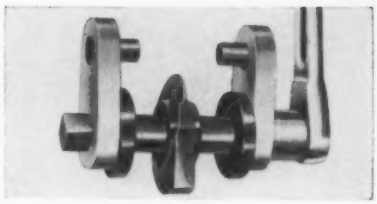
Portable Power Flarer is an electric motor-driven tool for flaring tubing easily and accurately in the shop or in the field. The new **Parker** flarer may be clamped in a bench vise for convenience or held in the hands when necessary. It features a unique flaring head and feed lever with specially designed tube holding clamps. Ball and roller bearings are used throughout with permanent lubrication. The frame is cast aluminum for high strength and light weight. It flares tubing from ¼ through ¾ in. O.D. (E7)

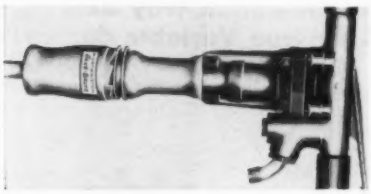




Automatic Chuck eliminates manual chucking. Using **Beaver Pipe Tools'** Electrimatic chuck, you merely flip the switch and the jaws instantly grip the pipe or rods. The chuck operates either forward or reverse. It is a precision built unit and the last word in simplicity. Wearing parts are made of hardened tool steel. It is said that this electrically operated chuck provides maximum time saving in cutting and threading rod stock and pipe. (E8)

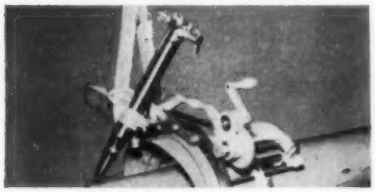
Spread Pipe Flanges safer, quicker and more economically with the Safety Boy Flange Spreader developed by **Wm. L. Riggs Co.** This lightweight tool features a tapered circular cam wedge and ratchet handle. It is easily anchored to the flanges on removal of one flange bolt. The cam wedge, inserted between the flanges, together with pressure applied by the ratchet handle, spreads a flange in a matter of seconds. It eliminates hammer blows, does not disturb the flange gasket and does not deform the flange face. (E9)





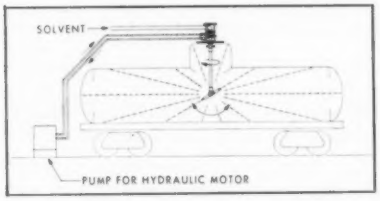
Paving Breaker in new light weight design has been developed by **Worthington Corp.** The 24-pound tool is ideal for light utility work, trimming around manholes and steel work, and brick and blacktop removal. Designed with a rubber buffer type retainer, it has a front end with a smooth symmetrical contour for easy operator handling on side wall work. The tool cannot overheat because it is equipped with exhaust air passes in the front. (E10)

One-Man Operated condenser tube cleaner by **Airetool Manufacturing Co.** is designed to quickly and thoroughly clean the most severely clogged tubes up to one inch in diameter. The cleaner is operated with a single-stage, geared, air driven motor to provide all the power necessary to clean even completely plugged tubes. A built-in flushing system, controlled by a stainless steel sleeve valve, keeps the drill head cool and removes cuttings. The cleaner weighs only 10 pounds and needs no support rigging. (E11)



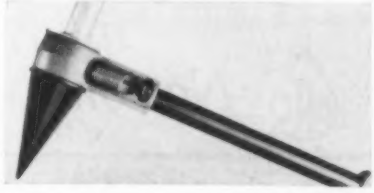
Pipe Shape Cutter attachment has been designed for pipe cutting and beveling machines. The cutter is designed to cut various shapes of pipe intersections automatically. Made by **H & M Pipe Cutting and Beveling Machine Co.,** the attachment utilizes a free-wheeling roller assembly that turns a full 360 degrees. This roller rides the surface of the pipe and automatically makes corrections for any imperfections. The advanced design results in increased precision and accuracy when cutting or beveling out-of-round pipe. (E12)

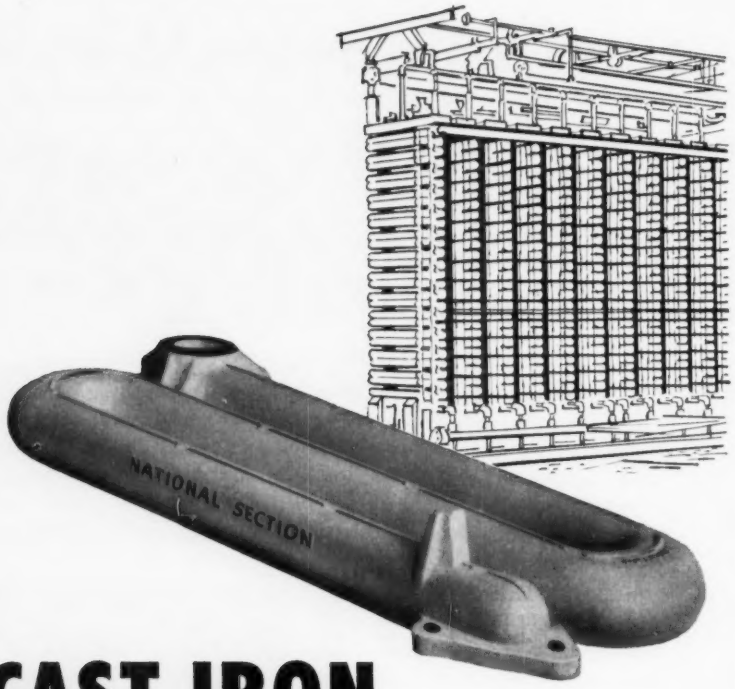
Impact Wrench developed with high speed photography. Analysis of speed films by **Gardner-Denver Co.** resulted in the designing of an entirely new impacting mechanism and the wrench. It is available in two models, both rated at ¾-inch nut-setting capacity. One model is equipped with a ¾-inch square drive and the other has a ⅝-inch built-in hexagon slip chuck. Accessories for the wrench include socket adapters, hexagon shank socket holders and universal joint socket adapters. (E13)



Tool Cleans Tanks. The tool uses a high-velocity stream of chemical solvents to remove scale, sludge and other undesirable deposits from internal tank surfaces. It is made by **Dowell,** and jets solvents from two nozzles in a revolving jet head powered by a hydraulic motor. The head rotates through 360 degrees both horizontally and vertically. Thus, solvents contact all internal tank surfaces. The jet tool can be suspended inside the tank through a manhole at the top or placed on the tank floor. (E14)

Ratchet Pipe Reamer by **The Toledo Pipe Threading Machine Co.** is said by the company to be especially effective for small pipe. Its seven flute design removes chips better and also improves the cutting qualities. According to the manufacturer it is designed for faster reaming, while at the same time eliminating any gouging. It feeds into the pipe with only light pressure, is easily resharpened and has a pipe capacity of ⅛ to 2 inches. (E15)





CAST IRON FOR COOLING CORROSIVES

National-U.S. Cast Iron Sections are the most widely used heat transfer units for sulfuric acid cooling in sludge recovery and contact plants—and have been, for many years. More and more, process engineers are looking into the possibility of using these units for other acids and corrosives in the chemical and petrochemical industries.

National-U.S. engineers can contribute valuable help from this background of experience in these fields. Call on them when you have a problem of heating or cooling corrosive materials in your operation.

Write or phone to the address below for help on your problem.

5802

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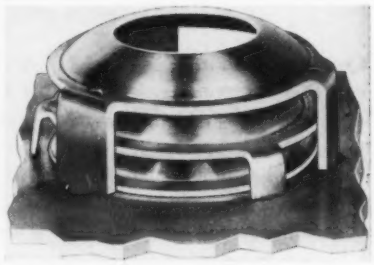
Equipment



Fractionation Tray Acts Like True Variable Orifice

A new fractionation tray has been developed. Called the Glitsch Ballast Tray, it is designed around a new-type valve unit which acts as a variable orifice to provide multi-staging of the slot-area through the various rates of vapor flow. A plurality of these ballast units, or "metering valves," are incorporated into each tray.

The design of the new ballast unit permits uniform distribution of vapor through the liquid across the tray, throughout a wide range of capacity; optimum vapor velocity through the liquid over a wide range of flow rates; a large turndown ratio by progressive staging of the vapor opening from low to increasingly high flow rates; and establishes a primary pressure drop at the vapor-liquid interface to obtain maximum tray efficiency.

Data obtained from operational runs, to determine the efficiency of the new Glitsch Ballast Tray, established the following: (1) The efficiency of the tray from very low vapor rates (within 10 percent of flood point) up to moderate vapor rates, is considerably higher than other trays of comparable capacity, and (2) the turndown ratio (the ratio of maximum to minimum vapor rates at which a high efficiency is maintained) is at least .9.0.

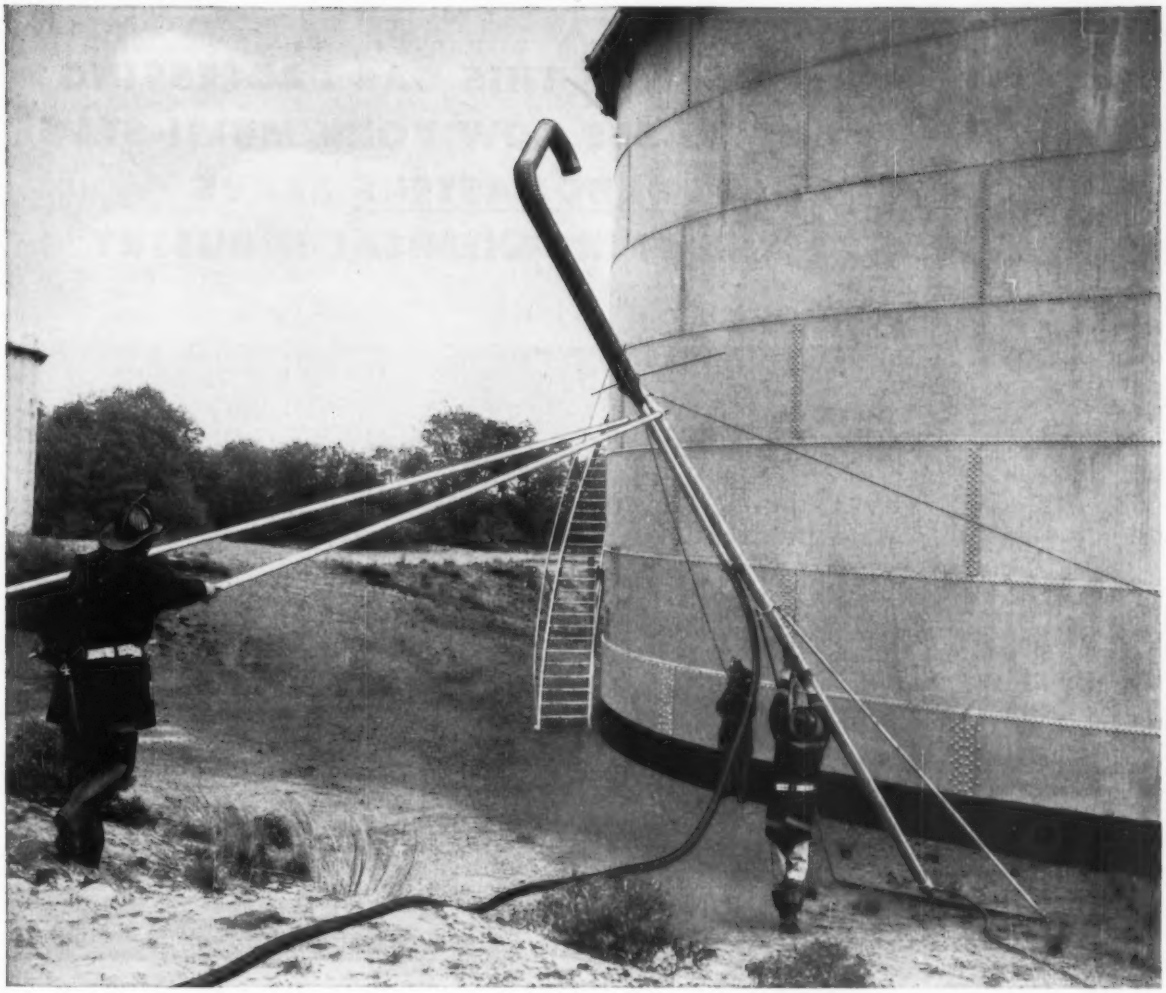
According to the manufacturer, the new tray has all of the good features of both conventional bubble cap trays and perforated trays—yet it eliminates inherent problems encountered with ordinary valve-type trays. The ballast unit acts as a true variable orifice as opposed to a semi-variable orifice as is the case with one-stage valves. Fritz W. Glitsch & Sons, Inc.

Circle E16 green card, last page

Heavy-Duty Process Pumps Offered At Low Cost

A new line of heavy-duty, medium-temperature process pumps, class SFLM, for handling temperatures to 300 F and for pressures to 600 psig has been introduced. The pumps are vertically-split, single-stage, single-suction units with overhung impellers. Capacities range up to 1,400 gpm, heads to 650 feet and discharge diameters are available in sizes of 1 to 4 inches.

According to the manufacturer, the SFLM pumps are ideal for a wide range



Rockwood Sure Shot Portable Telescopic FOAM Towers put you in a position to put out tank fires fast!

Lightweight! The tower columns, braces, and gin poles are made of lightweight, high strength aluminum alloys. Even the largest of the 4 towers (67') can be carried, fully assembled, to the erecting position by only 3 men. A crew of 5 can erect a tower and place a FOAM head in position in 5 minutes.

Hydraulically Operated! The FOAM tower column consists of a telescoping hydraulic ram that is elevated by water pressure. For extreme cold weather operation, a hydraulic kit is available that permits raising the tower by means of carbon dioxide or nitrogen pressure.

One Tower Places as Many as 4 Outlets! One tower puts several FOAM discharge outlets into position — making the Rockwood tower the equivalent of many conventional foam towers! A crew of 5 men can erect and install 4 FOAM heads in 17 minutes. And one tower can be used to place chemical foam outlets as well as mechanical foam types!

Minimum Care and Storage! The tower sections consist of three or four section hydraulic rams made of rust-proof aluminum. The lower tube has a heavy wall section to prevent physical damage. Towers retract to 20 ft. or less for ease in carrying on a fire truck or trailer.

Write for the full story!
Distributors in all principal cities.

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... to Cut Fire Losses

ROCKWOOD SPRINKLER COMPANY
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Please send me your illustrated booklet on Rockwood fire-fighting products, including your portable hydraulic tower.

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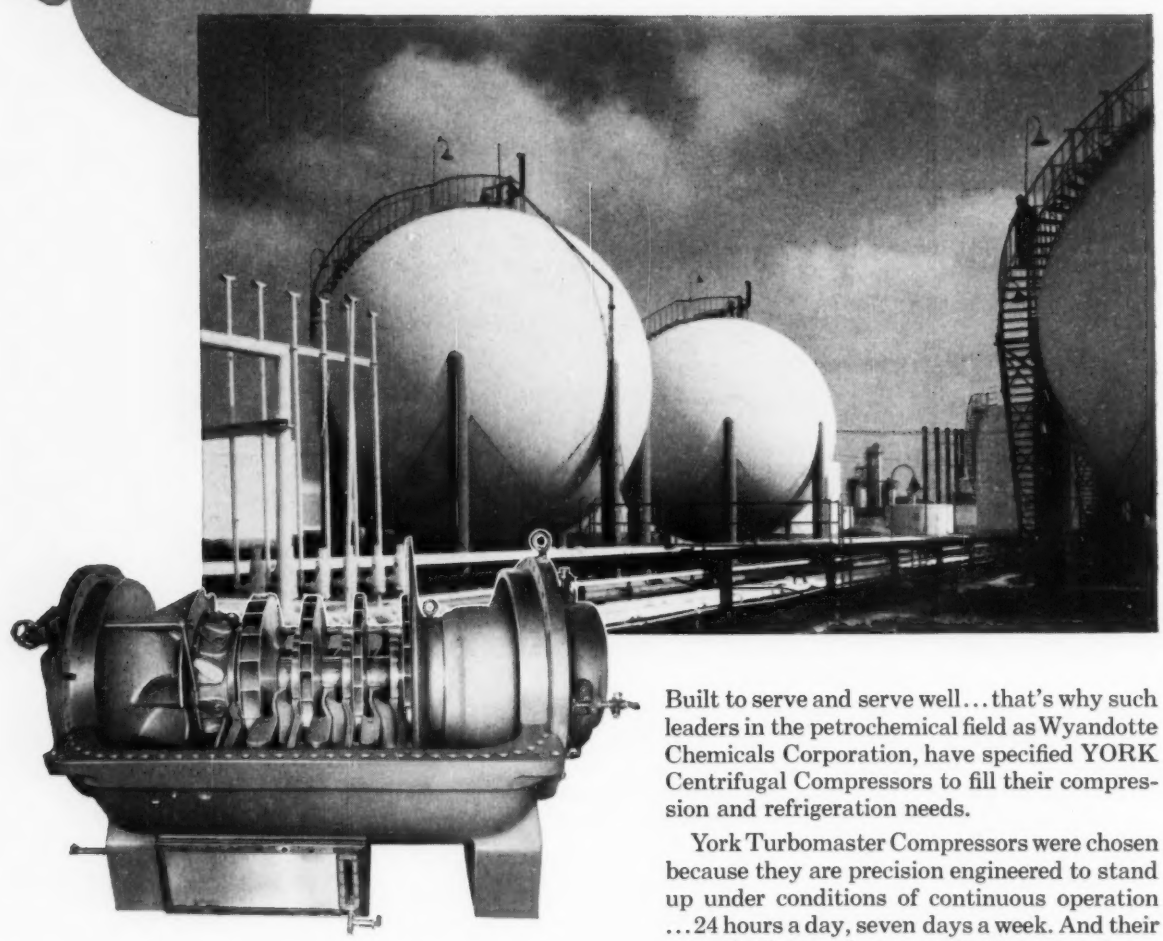
For more data on advertised products, use Readers' Service Cards, last page.

Look Inside THIS GAS PROCESSING PLANT TO SEE HOW YORK MULTI-STAGE CENTRIFUGAL TURBOMASTERS SERVE THE PETROCHEMICAL INDUSTRY



1. Simplified Compressor Has 400 Fewer Parts
2. Precision Bearing Fit Without Scraping
3. Patented Lightweight Shaft Coupling
4. Casing Stays Tight at Highest Pressures
5. One-Piece Oil Pump Eliminates Gears, Motor
6. Bearing Loads Reduced Due to Short Shaft
7. Shaft Seal Replaceable Without Removing Gas
8. Prerotation Vanes Give Accurate Capacity Control

Built to serve and serve well... that's why such leaders in the petrochemical field as Wyandotte Chemicals Corporation, have specified YORK Centrifugal Compressors to fill their compression and refrigeration needs.

York Turbomaster Compressors were chosen because they are precision engineered to stand up under conditions of continuous operation ...24 hours a day, seven days a week. And their rugged efficiency keeps production costs down, output up.

So look inside York Multi-Stage Turbomaster Compressors and see why they are ideally suited for use in catalytic cracking, gas compression, lean oil cooling, dewaxing, and for low temperature applications.

YORK

YORK CORP. SUBSIDIARY OF BORG-WARNER CORP.

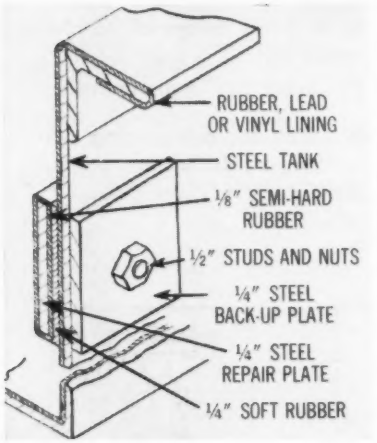
BORG-WARNER RESEARCH & ENGINEERING MAKE IT BETTER

Air Conditioning, Heating, Refrigeration and Ice Making Equipment • Products for Home, Commercial and Industrial Installation

of low and medium temperature applications where watercooling of the stuffing box and bearings is unnecessary. And because of the pumps' versatile design, conversion to water-cooled operation is simple and inexpensive. All parts are completely interchangeable with the company's companion line of SFL water-cooled units.

The new SFLM units provide heavy-duty construction with substantial initial cost savings. Ingersoll-Rand Corp.

Circle E17 green card, last page



Leaking Acid Tanks Can Be Repaired In Minutes

Leaking lined acid tanks can now be repaired in minutes, in position, with the new Camac Repair Plate shown in the above sketch. Repair plate is covered with ⅛ inch thick semi-hard rubber. A ¼ inch soft rubber gasket is vulcanized on the tank side of the plate. Repair plate comes with studs, nuts and a back up plate, which is used as a template while drilling through the tank from the lining side with a 9/16 inch drill. Studs are inserted on back of the repair plate through the holes. The back up plate is placed over studs and the nuts are tightened to complete repairs. No solvents or cements are required. Carl Buck & Associates.

Circle E18 green card, last page

Additive Increases Fuel's Electrical Conductivity

A new additive that shows promise of reducing static hazards in a wide variety of hydrocarbon fuels and solvents by increasing the electrical conductivity of such fuels now is available for developmental testing.

Known as SCA-100, the non-metal-containing additive may prove useful in both refinery stocks and finished products where there is hazard of explosion or fire induced by static discharge. It is ashless and compatible with other commonly used fuel additives.

Chemically a mixture of complex organic nitrogen-containing compounds,

FREE PRESSURE VESSEL DESIGN HANDBOOK

You can establish pressure vessel specifications in just a few minutes, using this ACF Pressure Vessel Design Handbook. Conveniently arranged design data covers a complete range of pressure vessels up to 131¾" I.D. and 844 pounds psi working pressure. Step by step instructions simplify your computations. A must for everyone who engineers or purchases pressure vessels. Mail this coupon today for your FREE COPY:

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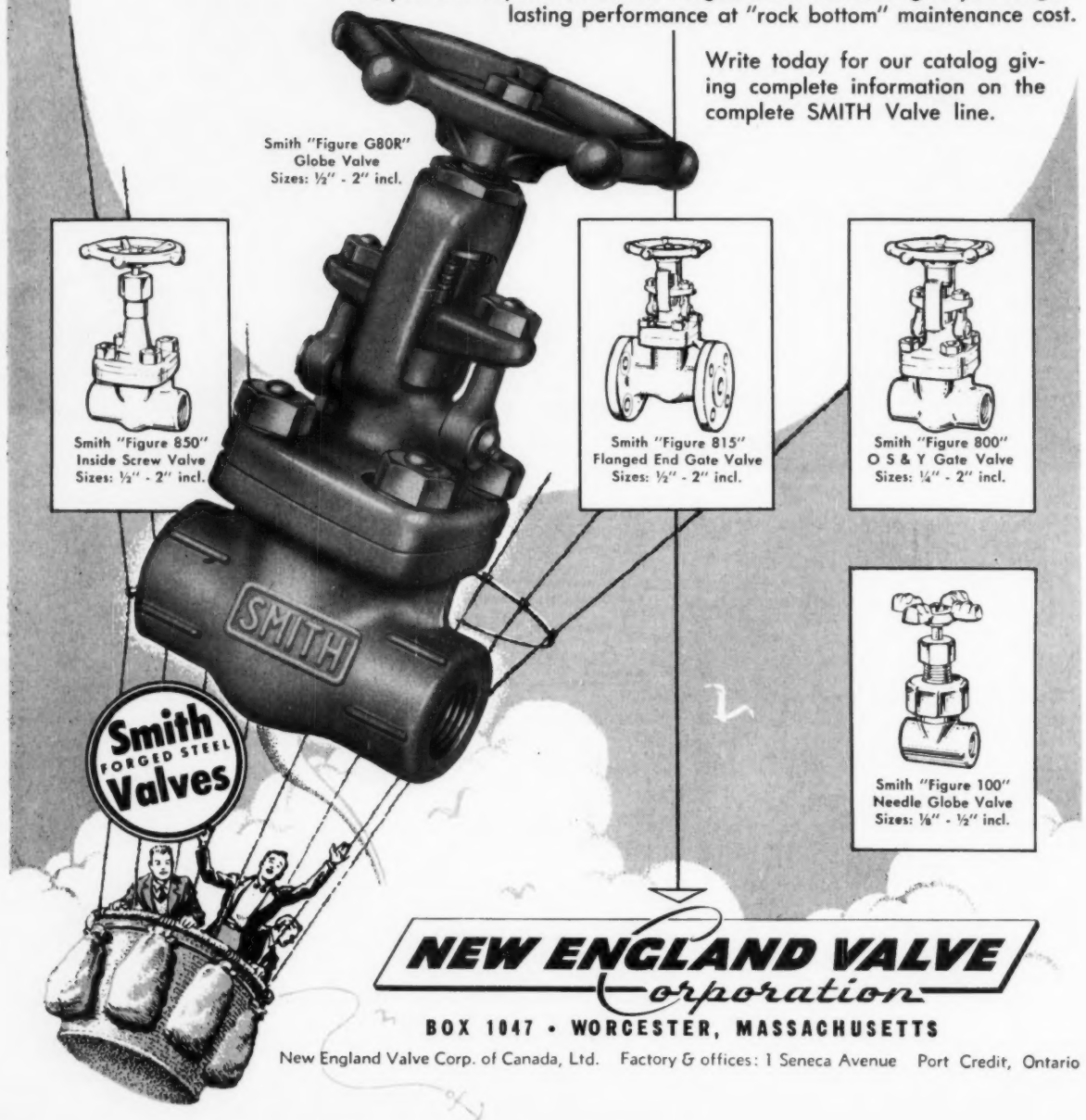
HIGH PERFORMANCE with LOW Maintenance Cost

WHY are thousands of SMITH Forged Steel Valves in use today in a large percentage of the major Refineries, Chemical and Petrochemical plants in this country and Canada? Why do so many engineers and maintenance men in these plants enthusiastically endorse SMITH Valves? WHY? — because SMITH Valves are especially designed and built to "take it" . . . to stand up under ever-increasing temperatures and pressures . . . to resist, day after day, the forces of corrosion.

Yes, you can depend on SMITH Forged Steel Valves to give you longer-lasting performance at "rock bottom" maintenance cost.

Write today for our catalog giving complete information on the complete SMITH Valve line.



Smith "Figure G80R" Globe Valve Sizes: ½" - 2" incl.

Smith "Figure 850" Inside Screw Valve Sizes: ½" - 2" incl.

Smith "Figure 815" Flanged End Gate Valve Sizes: ½" - 2" incl.

Smith "Figure 800" O S & Y Gate Valve Sizes: ¼" - 2" incl.

Smith "Figure 100" Needle Globe Valve Sizes: ⅛" - ½" incl.

NEW ENGLAND VALVE Corporation

BOX 1047 • WORCESTER, MASSACHUSETTS

New England Valve Corp. of Canada, Ltd. Factory & offices: 1 Seneca Avenue Port Credit, Ontario

the new additive appears to be effective in fuels which develop either positive or negative electrical charges. Possible applications include gasolines, rocket fuels, solvents, kerosine, distillates, diesel fuels, refinery feed stocks, and naphthas.

Exact recommendations as to usage must await results of field tests, but laboratory results indicate that concentrations of three to ten pounds of SCA-100 per 1,000 barrels of product give a significant reduction in static charge accumulation and an increase in electrical conductivity. E. I. du Pont de Nemours & Co.

Circle E19 green card, last page

Split Wedge Gate Valves Automatically Adjust Seats

A new line of Split Wedge Stainless Steel Gate Valves is made of Types 316 and J-20 alloys suited to a wide range of corrosive conditions. The valves are fitted with a Split Wedge of ball-and-socket design which automatically adjusts to the tapered seating surfaces. The discs, revolving freely in the wedge carrier, produce a self-cleaning action on the seat, which reduces the possibility of galling and seizing.

Among other features of the valve are a two-piece packing-gland design which eliminates binding of the follower when gland bolts are tightened unevenly. Chevron-type Teflon packing, body of through-port design, end flanges conforming to MSS SP-42 Specifications are featured. Size range of the 150-pound flanged end valve, is from ½ inch to 8 inches; of the 200-pound screwed end valve, from ½ inch to 2 inches. Jenkins Bros.

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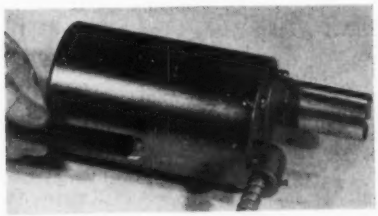
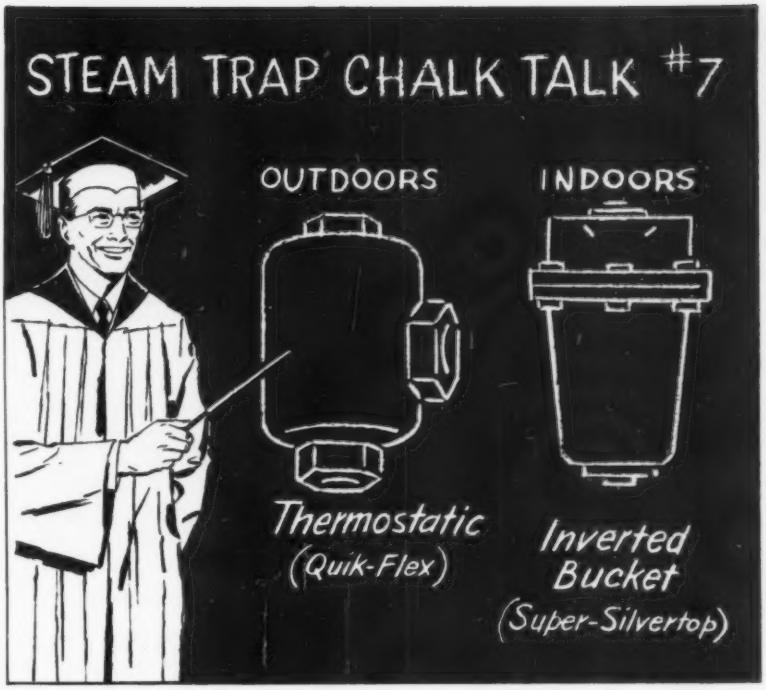


Flame Detection Device Can Be Used With All Fuels

A universal flame detection device that can be used on all types of industrial heating or processing burners has just been introduced.

Heart of the self-contained Ultra Vision Flame Detector is the recently unveiled ultraviolet-sensitive tube (shown being held).

The tube works with an amplifier cir-



Which design of trap is best for refineries?

- For outdoor refinery uses, the Anderson Quik-Flex Thermostatic Steam Trap fulfills all requirements of high condensate capacity, combining non-freeze features. Anderson Quik-Flex Traps will handle up to 31,000 pounds of condensate per hour. Their self draining design enables Anderson to guarantee every trap for two years against damage by freezing.

For indoor refinery applications, Anderson Super-Silvertop inverted bucket traps with their exclusive guided bucket, result in positive leakproof valve seating and longer life.

Be sure your refinery traps are engineered for each application. Send for Anderson's new catalog, "How to Select Steam Traps and Other Fluid Specialties". It contains selecting and sizing steam trap data on all types of pipelines and steam units, . . . indoors or outdoors.

A TRAP FOR EVERY PURPOSE

THE V. D. ANDERSON COMPANY
division of International Basic Economy Corporation
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Please send without obligation your 36-page steam trap engineering catalog, "How to Select Steam Traps and Other Fluid Specialties".

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ANDERSON QUIK-FLEX

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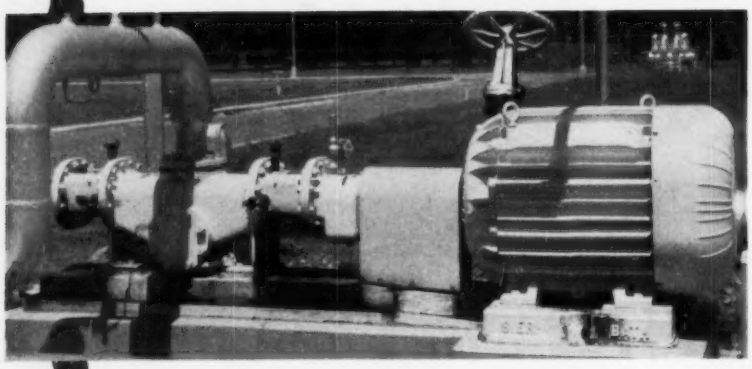
PUMPING VISCOUS MATERIALS?

(Boscan and Heavy Crudes—Asphalts—Tars—Waxes—Greases—Fuel Oil—Lubricating Oil—White Oil, etc.)



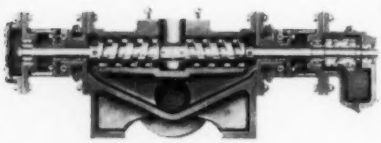
Get continuous, high-volume, low-cost pumping with

Sier-Bath SCREW PUMPS

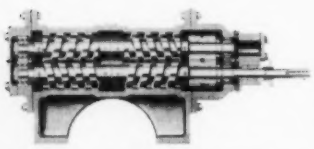
Especially designed and constructed for

HIGH VISCOSITIES: 32 to 5,000,000 SSU
HIGH CAPACITIES: 1 to 2,000 gpm.
HIGH PRESSURE: to 1,000 psi.

***Sier-Bath* SCREW PUMPS**



External Gear and Bearing Bracket Type for non-lubricating liquids and semi-liquids



Internal Gear and Bearing Type for lubricating liquids and semi-liquids

Sier-Bath Screw Pumps maintain high volumetric efficiency because "Dual-Controlled" precision rotor design prevents rotor-to-rotor or rotor-to-casing contact—provides a continuous flow without pulsation, hammering or vibration . . . without strains, misalignment and wear on rotors, shafts, bearings and gears.

Result: Dependable, uninterrupted pumping service—less maintenance—easier servicing—longer pump life—lower overall pumping costs.

Capacities from 1 to 2,000 gpm.; viscosities from 32 SSU to 1,000,000 SSU.; discharge to 1,000 psi. for viscous liquids, 200 psi. for water and light oils. Horizontal or vertical construction. Corrosion resistant alloys, special bodies, stuffing boxes and bearings for special needs. See "Yellow Pages" for your Sier-Bath representative or write Sier-Bath Gear & Pump Co., Inc., 9261 Hudson Blvd., North Bergen, N. J.

Sier-Bath ROTARY PUMPS

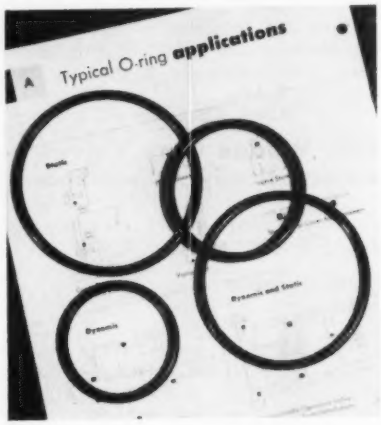
Screw Pumps **Gearex® Pumps** **Hydrex® Pumps**

Founded 1905 **Mfrs. of Precision Gears, Rotary Pumps, Flexible Gear Couplings** **Member A.G.M.A.**

Equipment

cuit to add up the impulses of electrical energy generated by the tube as it counts the ultraviolet rays present in all types of flame. The company said the system can be used with all fuels, including gas-oil combinations, and on both single and multiple burners. Minneapolis-Honeywell Regulator Co.

Circle E21 green card, last page



Bulletin Covers Design Applications For "O" Rings

A new bulletin, dealing with the design and application of "O" rings has just been published. The 20-page booklet discusses materials of construction, dynamic and static applications, use of back-up or non-extrusion rings, and groove design for this style of packing.

The bulletin is a source of much information on the construction and application of "O" rings and should be of considerable interest to the designer and to the user. The Garlock Packing Co.

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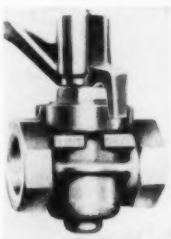
Vacuum Valve Works On Eccentric Principle

A new line of vacuum valves based on a design which is a radical departure from present vacuum valves, has been announced.



The valve design is based on a unique and exclusive eccentric principle. The plug, eccentric or cam-shaped in cross-section, matches an eccentrically-raised body seat. Carried on journals at either end, the plug rotates only a quarter-turn from full open to dead shut. The plug face and seat are in contact only when the valve is closed; in opening the valve, the slightest rotation of the plug breaks the contact, and the valve action is free, easy and frictionless.

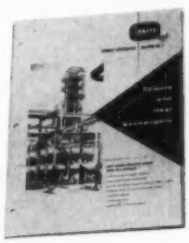
Tight shut-off in the valve is achieved by the eccentric action in combination with a resilient facing on the plug. The leak rate across the seat on a 3 inch

50 *years of results that satisfy just about everybody... except Oakite.* And we never will be satisfied. Our goal has always been to furnish even *better* cleaning at even *lower* cost—AND IT ALWAYS WILL BE!

Sure we're proud of the hundreds of Oakite "firsts" in developing fine cleaning compounds, cost-cutting methods, time-saving mechanical equipment. But we'll never rest on pride. As soon as we find a satisfactory answer to a cleaning problem—our research starts searching for an even better one.

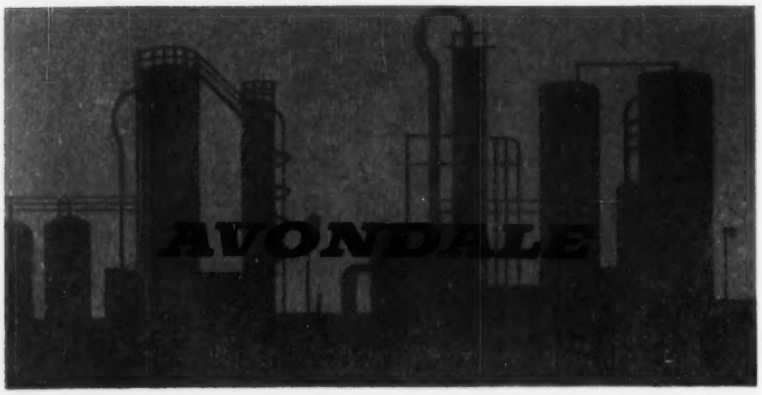
That's why so many users continue to rely on Oakite to reduce their "per unit" cost. They know that year after year, they are getting the best cleaning for the lowest possible cost.

OAKITE
50 1909-1959 SCIENCE
years' leadership in industrial cleaning



Oakite's pioneering in the future will mean what it has meant for the past 50 years: not only better products, but better service . . . better methods . . . better equipment. All deliberately designed with you in mind to give *you* the most for your cleaning dollar.

This handy guide is a distillation of 50 years of Oakite cleaning experience. It can save you valuable time—and cold cash, too—on all your cleaning operations. Send for it. Oakite Products Inc., 50A Rector Street, New York 6, N. Y.



manufacturer of high alloy steel products for the petroleum industry

Avondale's foundry division can produce high alloy steel castings weighing up to 12,000 lbs. each. A special CF4 low carbon 18-8 alloy is produced regularly. In addition, Avondale has the facilities and experience to fabricate pressure vessels of carbon steel, stainless steel or clad steel of almost any thickness. Our facilities include one of the largest heat treating furnaces in the United States.

Write for our complete brochure, *Foundry Work—Steels, Alloys & Non-Ferrous*

AVONDALE
MARINE WAYS, INC.
VERSATILE BUILDER ON THE MISSISSIPPI
P. O. Box 1030 • New Orleans, La. • UN 6-4561

Equipment

valve is certified at less than .003 micron cubic feet per hour. Certified stem leak rate on valves 3 inches and smaller is .01 micron cubic feet per hour. Each valve destined for high vacuum application is certified by a seat and stem seal test on a Helium-mass-spectrometer-type leak detector.

Straight-thru flow and a large port area assure low impedance, so necessary in high vacuum services. Initial and maintenance costs are low. Because of their basically simple design, these vacuum valves are among the very lowest priced valves for high vacuum service. Their freedom from friction and easy operation guarantee the lowest maintenance possible on critical services. De Zurik Corp.

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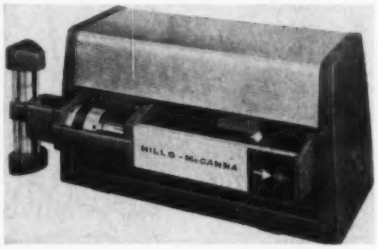


Streamlined Proportioning Pump Eases Maintenance

A smart new radio? No sir! Under this streamlined shield the newest in crank-type pumps is poised and ready to bring new economy and efficiency to metering and proportioning. The pump is one of four all-new Masterline models that go new inside and outside to ease maintenance, sharpen accuracy and lower operating costs.

Complete technical information is available in a bulletin released with the pump. Hills-McCanna Co.

Circle E24 green card, last page

Bulletin Includes New Vapor Velocity Graphs

The originators of wire mesh entrainment separators have just published a bulletin describing the latest advances in the technology of mist elimination, and containing data on mesh and grid construction, plus never-before published vapor velocity graphs. Metal Textile Corp.

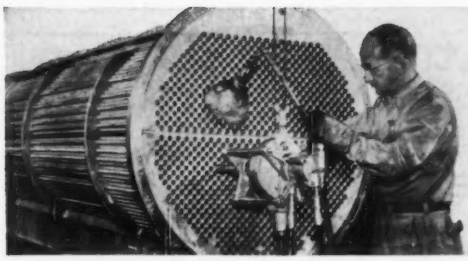
Circle E25 green card, last page

Stainless Steel Buyers Guide Lists 3,000 Firms

The Committee of Stainless Steel Producers has just published a new reference manual, "Buyers' Guide for Stainless Steel Products and Services." This 159-page book lists approximately 3,000 firms which make products of stainless steel or offer services pertaining to stainless steel.

The first of its magnitude ever published for the stainless steel industry, the

For more data on advertised products, use Readers' Service Cards, last page.



CONDENSER AND HEAT EXCHANGER CLINIC

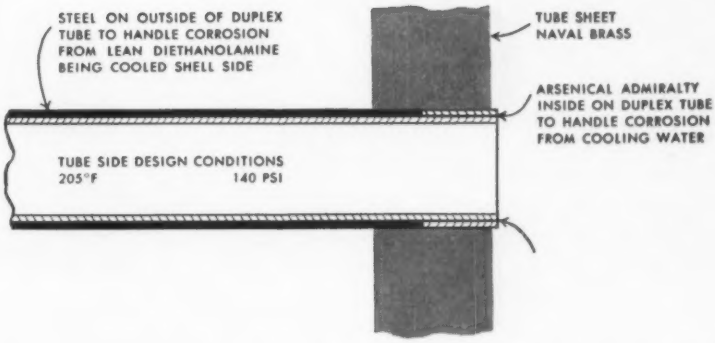
Edited by David S. Hibbard, Metallurgical Engineer
The American Brass Company, Buffalo 5, N. Y.

Duplex tube applications increase as corrosion and temperature-pressure problems grow more complex

New and improved processes in the chemical and petroleum industries—advancing design in power equipment both ashore and afloat, involving ever higher temperatures and pressures—are calling for more and more duplex tubes.

Working closely with both users and manufacturers of heat-exchange equipment, The American Brass Company is expanding its facilities to provide these special-purpose tubes in the combinations of metals and in the sizes and gages to meet new and growing needs.

Dual corrosion problems. Anaconda Duplex Tubes have been most often used to meet situations involving dual problems of corrosion. They are made by drawing tubes of copper or a copper alloy either inside or outside of steel tubes. However, they can be furnished in any combination of metals, including copper or copper alloys with other nonferrous metals or steel in a wide range of diameters and wall thicknesses.

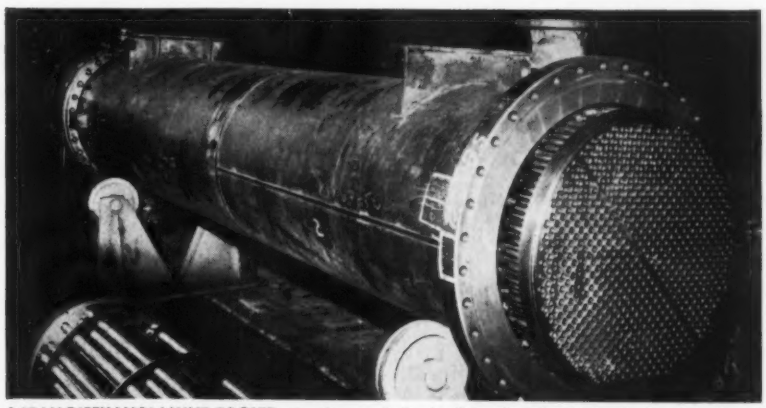

STEEL ON OUTSIDE OF DUPLEX TUBE TO HANDLE CORROSION FROM LEAN DIETHANOLAMINE BEING COOLED SHELL SIDE
TUBE SHEET NAVAL BRASS
ARSENICAL ADMIRALTY INSIDE ON DUPLEX TUBE TO HANDLE CORROSION FROM COOLING WATER
TUBE SIDE DESIGN CONDITIONS
205°F
140 PSI

SKETCH SHOWING CONSTRUCTION of Anaconda Duplex Tubes used in the cooler designed and built by Yuba. Tubes are ¾" O.D. x .065" wall x 16'1⅛" long. The 1 1/16" thick tube sheets of Anaconda Naval Brass are 31⅝" in diameter and 35⅞" in diameter.

For extra strength. More and more Anaconda Duplex Tubes are being used in those applications where internal or external pressures—or the pressure temperature combinations—are too great for a nonferrous tube alone. In this case the nonferrous tube is selected for the chemical properties required for the more corrosive fluid handled; and the steel tube gives the needed strength.

U-bends. Duplex tubes can be readily bent to form the hairpin or U-bend tubes required for the compact U-bend tube design so advantageous in heat exchangers where wide temperature differences exist in the unit.

Technical Assistance. Specialists at the American Brass Company are constantly working with manufacturers and users of heat-exchange equipment, helping to solve process problems. This experience is available to you. For more detailed information on Duplex Tubes, U-bend Tubes, address: The American Brass Company, Buffalo Division, Buffalo 5, New York. In Canada: Anaconda American Brass Ltd., New Toronto, Ontario. 6879



A LEAN DIETHANOLAMINE COOLER using Anaconda Duplex Tubes (see detail sketch above) designed and built by Yuba Heat Transfer Division of Yuba Consolidated Industries, Inc., Honesdale, Pa. This unit will cool Lean Diethanolamine at the new 19,000 barrels per stream day delayed coker designed, engineered and being constructed for Socony Mobil at Paulsboro, N. J. by The Lummus Company.

ANACONDA®
TUBES and PLATES for CONDENSERS & HEAT EXCHANGERS Made by THE AMERICAN BRASS COMPANY

For more data on advertised products, use Readers' Service Cards, last page.

Reduce Equipment Downtime And Replacement Costs

- **Resistant to Wear, Corrosion and High Temperature**
- **In All Stainless Steel and Ferrous Alloys**

Welded super alloy overlays applied only to critical areas subject to corrosion, erosion, abrasion, heat, thermal shock or impact, provide superior surface properties and precision finishes.

Whatever the size or shape, the metal overlay can be fused to all stainless and ferrous alloy O.E.M. and worn equipment at low cost.

For practical, prompt assistance on your application, send in your blueprint or call on our trained specialists.

Write for detailed literature

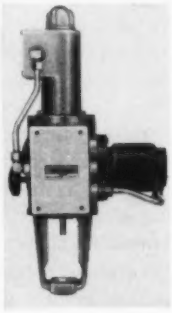
Cleveland Hard Facing, Inc.
3047 STILLSON AVE. • CLEVELAND 5, OHIO

guide is especially directed toward purchasing agents, designers and fabricators. It contains 188 specific and general stainless steel product categories, followed by manufacturers names and locations. Thus, where a specific component is not actually listed, it can usually be found, or some clue to potential suppliers obtained, under the listing of general fabricators of the type of product desired. The product section also includes manufacturers of semi-fabricated forms including expanded, perforated and textured stainless steel products. American Iron and Steel Institute.

Circle E26 green card, last page

Economical Valve Control With Electric Actuator

A new all-electric actuator is available. The Model D-62XW electric actuator provides economical automatic or remote manual positioning for throttling control of many types of valves, dampers, louvers, metering pumps and speed changers. It can also be used for on-off remote pushbutton control with optional position indication.



It affords precise proportional positioning by means of a slidewire feedback used in conjunction with one of several voltage balance systems now on the market. It is available in a variety of travels from ½-inch to 4 inches, with a maximum thrust of 700 pounds. Stroking speeds are from 8.5 inches per minute at 100 pounds load to 2.5 inches per minute at 700 pounds load. A continuously connected handwheel allows for easy manual operation. Integral positioning stem and mounting yoke make the actuator especially suitable for field mounting. It is a rugged, compact and lightweight unit. Over-all assembly of actuator and yoke is only 26 inches high and weighs less than 35 pounds. Conoflow Corp.

Circle E27 green card, last page

Ejectors Are Answer To Discharging Waste Effluent

An answer to the problem of discharging waste effluent into streams, sewers or lakes without danger of pollution is provided by ejectors installed in activated sludge processes. This system cuts by 95 percent the high concentration of bacteria cells and is said to provide 20 to 25 percent oxygen absorption compared to a 4 to 5 percent absorption by porous plate or mechanical systems at a saving of more than 40 percent in horsepower.

Easily planned, properly balanced systems are simple to install and operate in

DU PONT *Petroleum Chemicals* NEWS

Number 95 in a Series of Bulletins for the Petroleum Industry

MARCH-APRIL 1959

Du Pont Helps Refiners Set Up Linear Programming

by Herb Bailey

Herbert O. Bailey, one of Du Pont's refinery technologists, and Joseph Testa discuss a linear programming problem as it is being fed into the computer. In just a few minutes the solution will emerge. Done by hand, the problem would have required weeks of time and reams of paper to solve.

Du Pont Develops AFA-1 for Aviation Gasoline

A new additive (AFA-1) is now being offered by Du Pont as a corrosion inhibitor for aviation gasoline. Since low dosages of AFA-1 are effective, it offers refiners opportunities for substantial savings in corrosion inhibitor costs. Another advantage of the low dosage is that the water tolerance test on aviation gasoline is more easily passed.

For details on this product and its use, call your Du Pont representative at the nearest Petroleum Chemicals Sales Office.

In today's highly competitive petroleum industry, maximum economy in all phases of operation has practically become a management "must."

An important tool in effecting economies is linear programming.

Linear programming, through the use of electronic computers, makes it easily possible to determine the economic effect of all known processing and blending variables in the production of gasoline. In this way human errors arising from prejudgment are minimized.

In order to help the refining industry take fuller advantage of the economy and efficiency offered by the use of linear programming, the Du Pont Petroleum Chemicals Division now offers a new technical service.

This service consists of helping refiners to organize the vital variables of processing and blending in such a way that modern calculation methods can

ADVERTISEMENT—Prepared for the Petroleum Chemicals Division of E. I. du Pont de Nemours & Company (Inc.)

OVER

DUPONT *Petroleum Chemicals* NEWS

CONTINUED *Linear programming*

be used to get an integrated analysis of all gasoline manufacturing operations.

The DuPont refinery technologists have completed numerous linear programmed studies of gasoline blending economics for customers. Operating variables and incremental manufacturing costs are incorporated in the evaluations.

These studies include such items as: the volume and value of the gasoline components in each blend; optimum reformer severity; the volume of components which should be purchased or sold; the product quality shortage or giveaway on all inspections related to specifications; the loss sustained by diverting components to other grades of gasoline or products through choice or necessity; the range over which the economic variables in a study may shift without changing the recommended blends; and, of course, the economic usage of TEL as an octane control additive.

While such studies obviously cannot always result in major savings, in one instance it was shown that a loss of over $1.00 per barrel was being suffered by diverting one component to a less profitable alternate use. In a second instance, the price being paid for a purchased component was much more than its worth to the user. Such results as these could be determined in an analysis of your own operations.

The men responsible for our linear programming service

JACK S. BELLAH joined the Petroleum Chemicals Division as Refinery Technologist in 1953. He is a graduate chemical engineer from the University of Tennessee. He spent six years at the Socony-Vacuum Oil Company working on petroleum test programs, economic studies, process engineering, and product development. He also worked for Mathieson Alkali Works and at Stanolind Oil and Gas Company in Tulsa, and the Refinery Engineering Company before coming to DuPont.

HERBERT O. BAILEY holds a chemical engineering degree from Rensselaer Polytechnic Institute. Mr. Bailey spent 12 years in the Technical Service Division of Esso Standard Oil Company doing refinery test work, gasoline blending studies, and crude oil and finished product evaluations. He joined DuPont in 1953, starting in sales. Last year he joined the Planning Section in Wilmington as a Refinery Technologist.

New Series–Additives Handling Bulletins

Just a year ago DuPont began a service designed to make the use of petroleum additives as easy and economical as possible for DuPont customers.

It consists of a series of bulletins on special subjects of interest to those who buy additives.

The first bulletin deals with the use of duplex pumps in place of the simplex type for keeping additives free-flowing in cold weather.

Another bulletin covers in detail the knowledge needed for the easiest and most efficient handling of DuPont Rust Preventive No. 2.

These bulletins are written by the men of the "Operations Group." All of them are experienced in the handling of tetraethyl lead and other petroleum additives.

SALES OFFICES

Chicago 3–8 So. Michigan Ave. . . RAndolph 6-8630
Cleveland 15–101 Prospect Ave. . . . . MAin 1-3422
Houston 2–
705 Bank of Commerce Bldg. . . . . CApitol 5-1151
Los Angeles 17–612 So. Flower St. MAdison 4-1354
New York 20–
45 Rockefeller Plaza . . . . . COlumbus 5-2342
Philadelphia 2–3 Penn Center Plaza LOcust 8-3531
Pittsburgh 22–1 Gateway Center . . . ATlantic 1-2933
San Francisco 4–111 Sutter St. . . . . EXbrook 2-1934
Seattle 3–4003 Aurora Ave. . . . . MElrose 2-6977
Tulsa 1–1811 So. Baltimore Ave. . . . LUther 5-5578
In Canada–DuPont of Canada Limited, Petroleum Chemicals, 85 Eglinton Ave. East, **Toronto 12**–Ontario . . . . . HUdson 1-6461
OTHER COUNTRIES: Petroleum Chemicals Division, Export Sales, Wilmington 98, Delaware, PRospect 4-2962.

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Better Things for Better Living
. . . through Chemistry

Du Pont Tetraethyl Lead and other Petroleum Additives

OVER

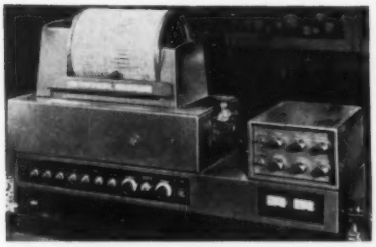
ADVERTISEMENT—Prepared for the Petroleum Chemicals Division of E. I. du Pont de Nemours & Company (Inc.)

A-10220

Printed in U. S. A.

new or present installations . . . offer a practical means of providing supplemental capacity to existing facilities. Cost of installation, maintenance and power is exceptionally low. Pemberthy Mfg. Co.

Circle E28 green card, last page



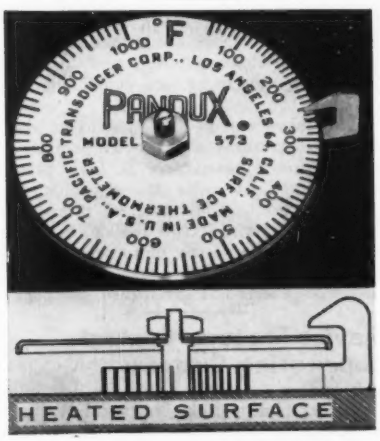
Better Infrared Analysis With Spectrophotometer

A new double beam, automatic recording infrared spectrophotometer, incorporating the most advanced spectroscopic features, has just been developed.

Among the features unique to the new Model 221 are an automatic gain control system, and a programmed scanning speed system.

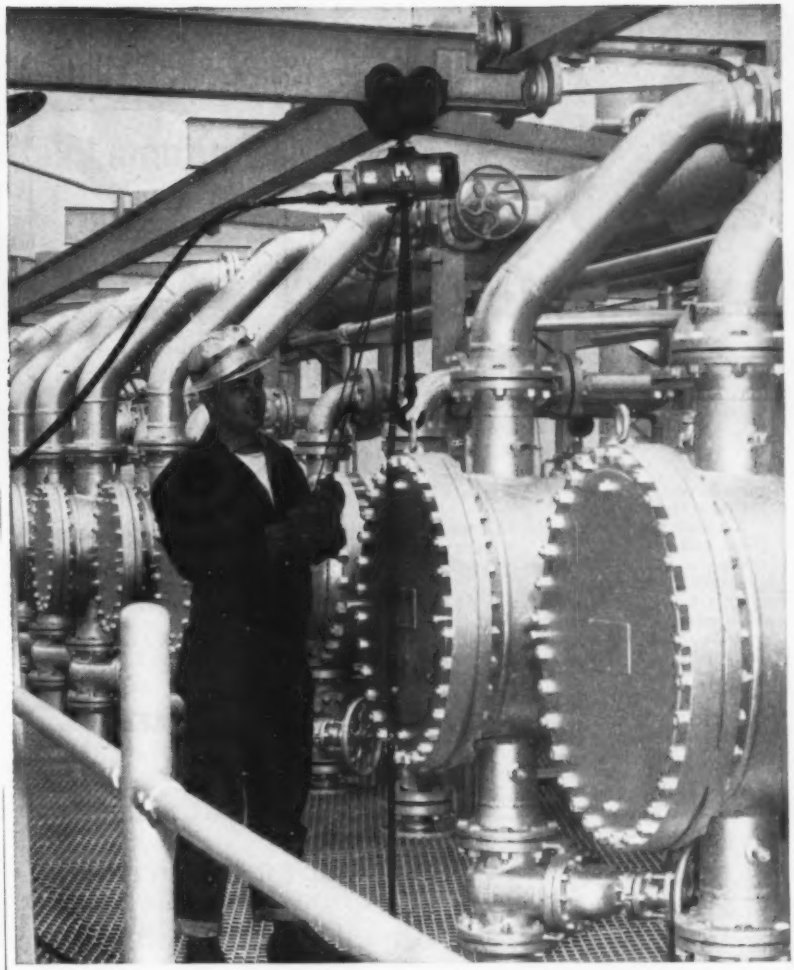
The spectrophotometer scans a spectral range from 1.0 to 15.5 microns with standard NaCl optics, and a range from 0.5 to 38 microns with other available prisms and interchange assemblies. With standard NaCl optics accuracy is ±0.015 microns, reproducibility is ±0.005 microns, and resolving power is 0.02 microns at 12 microns.

Stray radiation is less than 2 percent at 15 microns with automatic filter, and less than 0.1 percent at 9 microns with automatic filter. Transmittance reproducibility is ±0.5 percent. Perkin-Elmer Corp. **Circle E29 green card, last page**



Thermometer Checks Surface Temperature In 60 Seconds

A new Spot Check Surface Thermometer has been developed. This is a new type of thermometer, made entirely of stainless steel, with a range of from 50 to 1000 F. It is easy to read—compact



For lifting channel covers, tube bundles, or any heavy lifting job up to two tons, there's a Gardner-Denver air hoist to handle it.

Handy hoist for refinery maintenance

On day-to-day maintenance or during turnaround periods, let Gardner-Denver air hoists lighten your lifting jobs. They're fast, safe, easy to operate. Here's why:

Air motor power—can't be damaged by overload stalls. Can't spark or burn out. Motor is sealed from dirt and corrosive fumes.

Powerful brake—prevents racing, will hold load in complete control even if air line is disconnected.

Load chain—roller or link. Tested to two times maximum rated load. Adjustable safety stops shut hoist off when load is at maximum limit.

Safety hook—made of forged steel . . . ball-bearing mounted for swiveling. Will accommodate load in any position.

Controls—control bar or pendant control system provides effortless one-hand lifting or lowering.

Choose the safe, spark-free lifting power you need from the Gardner-Denver air hoist line. Seven models from 150 lb. to two tons. Write for Bulletin 86.

EQUIPMENT TODAY FOR THE CHALLENGE OF TOMORROW

GARDNER - DENVER

Gardner-Denver Company, Quincy, Illinois

In Canada: Gardner-Denver Company (Canada), Ltd., 14 Curity Avenue, Toronto 16, Ontario

For more data on advertised products, use Readers' Service Cards, last page.

NEW Metal Blade Aeromaster* Fan

AEROMASTER fans 54" to 22' for cooling towers and radiator-type coolers.

Lasts Longer • Costs Less

Efficiency . . . economy . . . durability—three important standards—are yours in the AEROMASTER fan.

AEROMASTER fans are efficient because they embody advanced aerodynamic principles. True airfoil blade sections give maximum air delivery.

AEROMASTER fans are economical because adjustable pitch angle of the blade permits a flexibility of setting which enables you to decrease fan load to an accurate minimum horse-power requirement. Design features reduce labor and installation costs.

AEROMASTER fans are durable because they are made from corrosion resisting, silicon-magnesium, aluminum alloys with high tensile strength, fine grain structure and increased endurance limit.

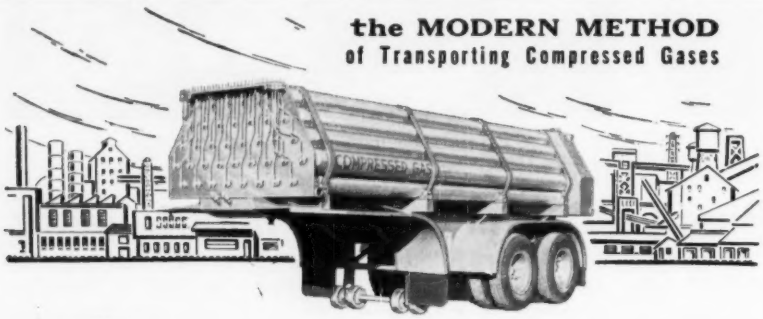
For more details write to KOPPERS COMPANY, INC., Aeromaster Fan Dept., 8103 Scott Street, Baltimore 3, Md.

*Koppers Trademark

KOPPERS Aeromaster Fans

Engineered Products Sold with *Service*

the MODERN METHOD of Transporting Compressed Gases



INDEPENDENT IECCO ENGINEERING CO.

gas supply TRAILERS *tailored just for* YOU

- MANIFOLD & CONTROLS — for YOUR Gas and Handling Requirements
- CAPACITY — to meet YOUR Requirements
- SAFETY — Cylinders, Safety Devices, Controls etc., All in accordance with ICC Requirements for YOUR Protection.
- CHASSIS — by leading Chassis Manufacturers with Service Branches throughout the United States for YOUR Convenience.

SEND YOUR INQUIRIES TODAY TO

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Manufacturers of

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CYLINDERS AND GAS PRODUCING EQUIPMENT
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O'FALLON 6, ILLINOIS

Equipment

and very fast-operating. Merely lay the instrument on the surface to be checked. Within 60 seconds the thermometer will reach stability, and exact temperature can be easily read. In addition to surface temperatures, it reads ambient temperatures in furnaces and other enclosed spaces; as well as in non-corrosive liquids and gases, up to 1000 F.

The thermometer comes equipped with a magnet assembly and is accurately calibrated to within plus or minus 2 percent, and can be reset by the user at any time. Pacific Transducer Corp.

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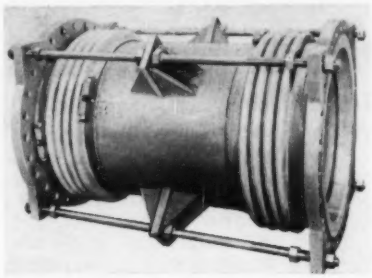


Expansion Joint Absorbs Multidirection Movement

A new line of bellows-type expansion joints that accommodate pipe movement in any direction has been announced. Known as Zallea universal expansion joints, these packless, corrugated-bellows units protect power and process piping systems by absorbing the following types of displacement—axial movement, lateral deflection and angular rotation, either singly, or in any combination.

Basic elements of these units include two hydraulically-formed bellows, a center section of pipe and appropriate tie rods. They are manufactured in standard sizes from 3 to 72 inches diameter and, depending upon pressures and temperatures to be encountered, are supplied with one of three different types of bellows—non equalizing, self equalizing or HyPTor toroidal.

The joints can be designed to handle medium pressures at high temperatures or medium temperatures at high pressures. Standard units are available to pressures up to 2500 psi and temperatures from minus 320 to 1600 F. Special units are available for more severe conditions. Zellea Bros.

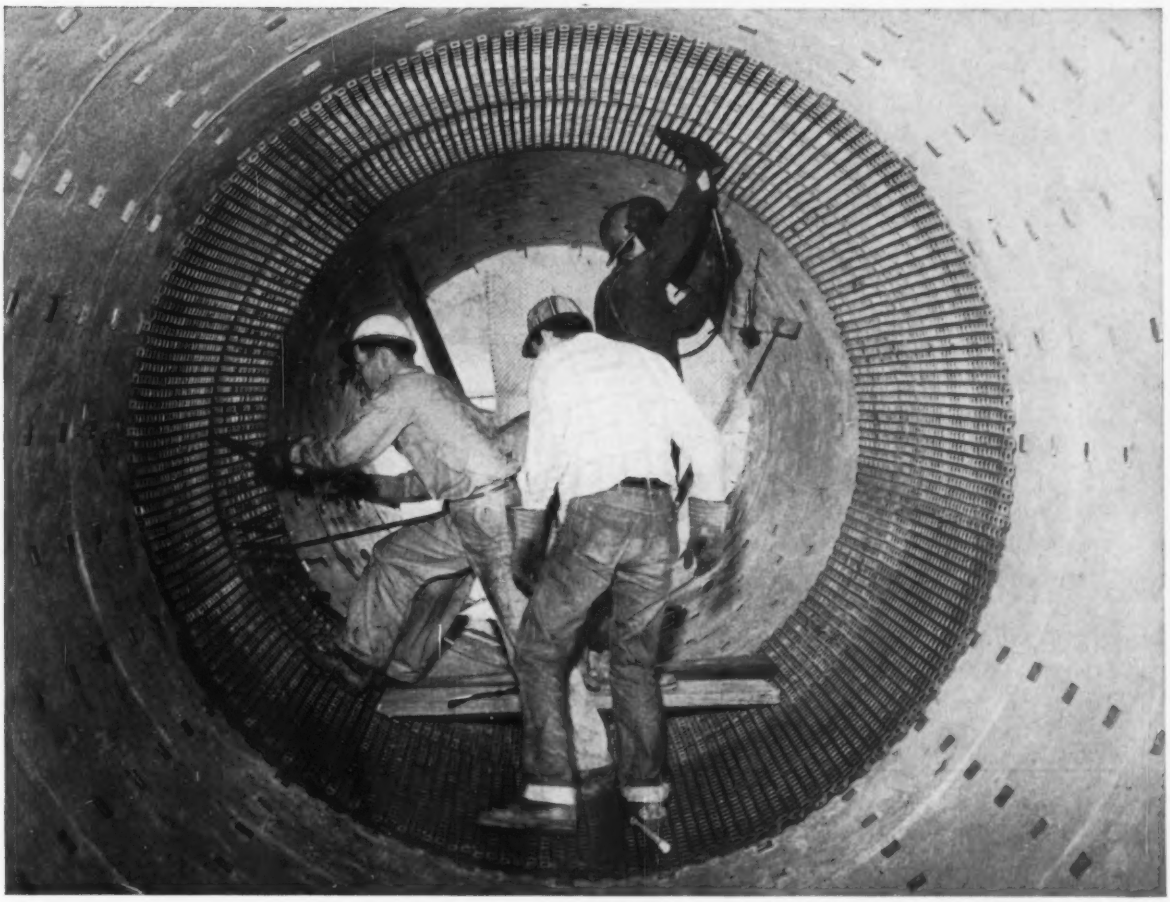
Circle E31 green card, last page

Device Protects Central Lubricating Systems

A new protective device for use on force-feed lubricating systems has just been announced.

The new product, called the "Lube-Line Alert," is installed at each terminal point of lubrication by simply cutting the line and connecting the fittings. The unit is then connected electrically to any desired audio, visual or mechanical warning device. If the flow of lubricant through the unit is interrupted for any

Protecting catalyst lines from erosion with a refractory castable lining bonded with **Atlas Lumnite Cement**



Gunite Contractor: J. A. McCollum, Inc., Marlton, N. J. Castables: Mexico Refractories Co., Mexico, Mo.

In this catalyst line at a large Gulf Coast refinery, steel mesh is being welded into place over a 3-inch lining of insulating refractory castable bonded with Lumnite calcium-aluminate cement. Over the mesh, a 1-inch thickness of high-strength castable will be gunited, providing a 2-component refractory concrete lining that will resist severe erosion and abrasion caused by catalyst fines.
Monolithic refractory concrete linings eliminate troublesome mortar joints. They are easily placed, conforming to any contour. Castables are recommended because they are simply mixed with water and placed – concrete reaches service strength in 24 hours. Castables containing Lumnite cement are available from leading manufacturers of refractories for a variety of applications in refinery equipment. For information, write Universal Atlas, 100 Park Avenue, New York 17, N. Y. "USS," "Atlas" and "Lumnite" are registered trademarks.

Universal Atlas Cement
Division of
United States Steel

L-184

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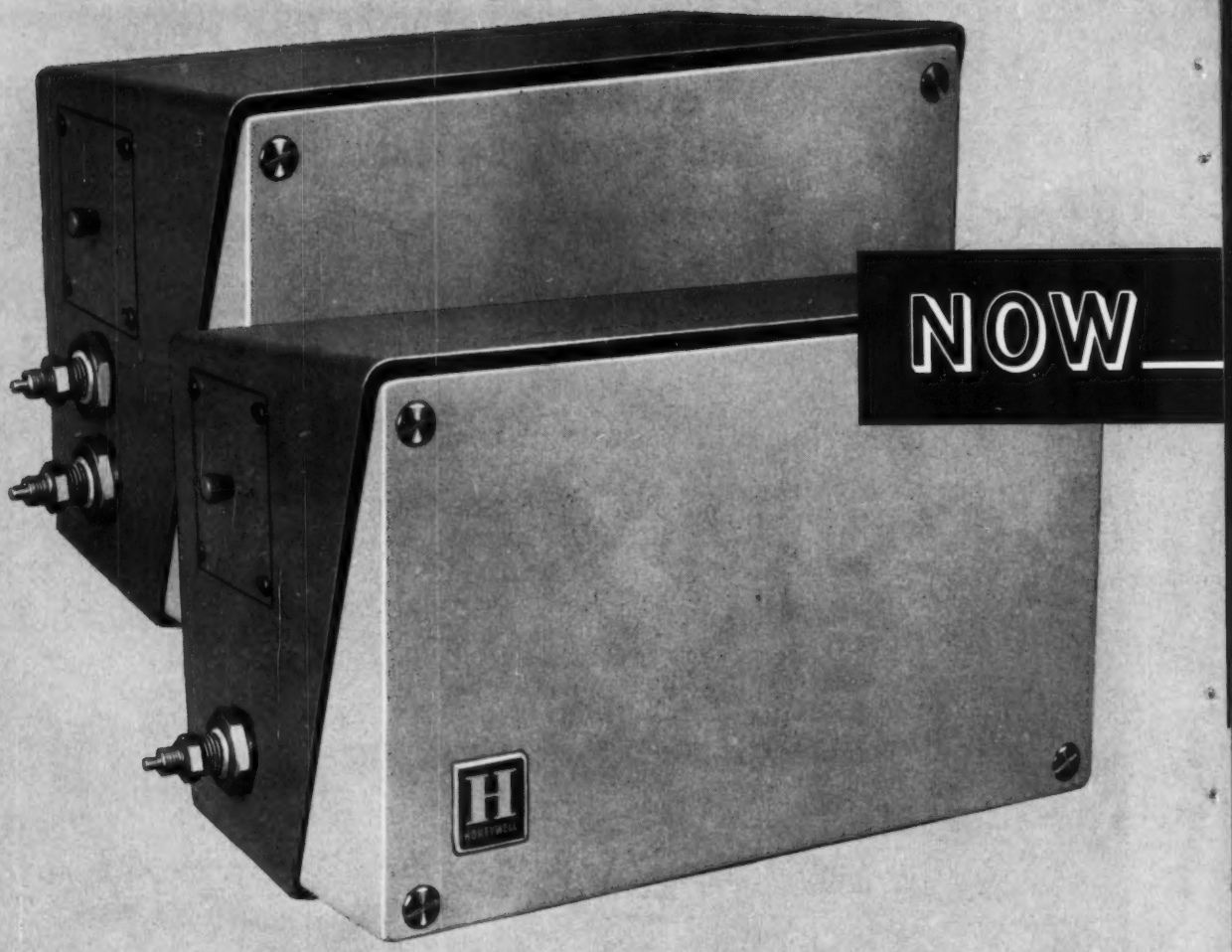
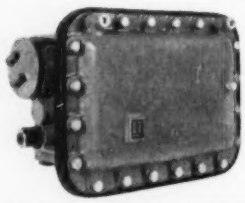


RELAY RACK MOUNTING permits four transducers to be mounted abreast on a standard 19-inch-wide relay rack with 7-inch vertical spacing.



EXPLOSION-PROOF HOUSING meets conditions of operation specified under Class I, Group D, Division 1 of the National Electrical Code.

WEATHERPROOF HOUSING is diecast aluminum, dust-tight, splash-proof, for indoor or outdoor mounting. Supplied with vertical surface mounting accessories. Valve or pipe mounting bracket accessories available. This housing meets Class I, Group D, Division 2 requirements of the National Electrical Code.

	P/I TRANSDUCER	I/P TRANSDUCER
Input	3-15 psi	4-20 ma d-c
Output	4-20 ma d-c	3-15 psi
Accuracy	±¼% of span	±¼% of span
Ambient temperature range	−40° to +150°F	−40° to +150°F
Maximum load resistance	800 ohms	————
Supply	42 ±2 V d-c	20 psi
Air Consumption	————	less than 0.35 cfm

adapt your pneumatic loops to centralized, electric control with *ElectriK Tel-O-Set** TRANSDUCERS

Now, get the desirable advantages of electric control with your present *pneumatic* instruments. New *ElectriK Tel-O-Set* transducers let you make use of modern data processing techniques . . . centralize multi-plant control . . . and bring additional facilities into your control system.

The P/I (pressure-to-current) transducer converts the standard 3-15 psi signal of your present pneumatic instruments to a standard electric signal which is fed to the electric control center. Its counterpart, the I/P (current-to-pressure) transducer, converts the signal from the electric control center back to the standard 3-15 psi signal which is fed to the pneumatic control loop. Used together with your present pneumatic instruments, they permit long-distance, high-speed electric transmission of process variables, eliminating the lags characteristic of extremely long runs of pneumatic tubing.

These twins have a calibrated accuracy of $\pm \frac{1}{4}\%$ of span. They're completely transistorized for long, reliable service. Only two wires, forming a series circuit between transducer and receiver, are needed to carry the signal and line power is not required in the field. Both units are trim, compact, and easily installed, adjusted and maintained.

Get complete details from your nearby Honeywell field engineer. Call him today . . . he's as near as your phone.

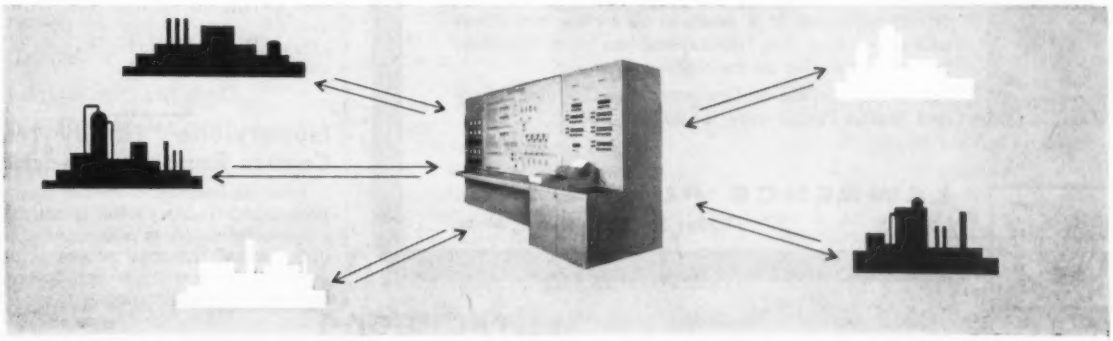
MINNEAPOLIS-HONEYWELL, Wayne and Windrim Avenues, Philadelphia 44, Pa.

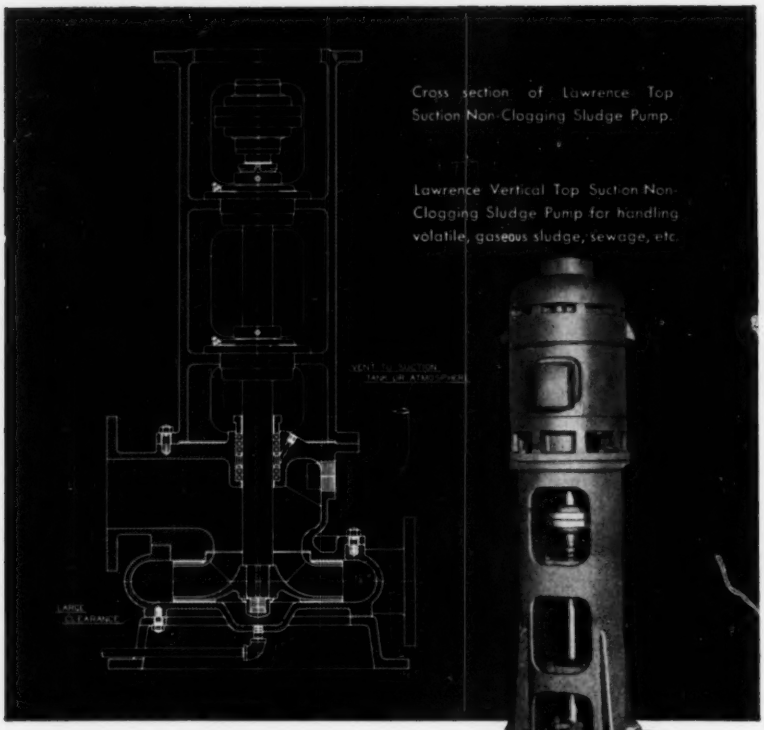
*Trademark

Honeywell

H HONEYWELL *First in Control*

Diagram symbolizes use of transducers in a "wheel-type" plant to convert signals from existing pneumatic instruments to electric signals for data processing or electric control. White silhouettes represent future plants.




Cross section of Lawrence Top Suction Non-Clogging Sludge Pump.
Lawrence Vertical Top Suction Non-Clogging Sludge Pump for handling volatile, gaseous sludge, sewage, etc.

PUMP *volatile*

SLUDGES AND SLURRIES

...without clogging
...under a low net positive suction head (NPSH)
...without gas or vapor binding

The Lawrence Non-Clogging Top Suction Pump is designed specifically to handle volatile sludges and slurries. Large clearances through the impeller and casing completely prevent clogging. Volatile gases or vapors liberated at the impeller entrance (the point of lowest pressure), are pushed up and out of the way and can be vented back to the suction tank or exhausted to atmosphere.

This type of pump can operate with a very low Net Positive Suction Head (NPSH) and never become gas or vapor bound. It is made in all metals and alloys such as: — cast iron, bronze, stainless steel, Hasteloy, etc. — depending on the material pumped.

For further details on Lawrence Non-Clogging Slurry and Sludge Pumps write for Bulletin 206-4.

LAWRENCE PUMPS INC.
371 Market Street, Lawrence, Mass.

Equipment

reason, the signalling system is activated. This may be a bell, whistle, horn, master control board light or a relay to shut off the motor or ring a telephone.

The standard unit is usable with any viscosity oil or synthetic lubricant, and for pressures up to 10,000 psi. Explosion-proof units are also available for use where conditions require them. Manzel division of Houdaille Industries, Inc.

Circle E32 green card, last page

Nitrile Rubber Chamois Feels Like The Real Thing

Chamie-Tex, a product of West Germany, is a synthetic chamois that looks and feels like a natural one but has other advantages and sells for much less. It works like a chamois but has these advantage: it doesn't mildew, can be washed in any detergent, is unharmed by grease, oil or solvent, develops no viscous deposits and improves with use.

Chamie-Tex is a completely manufactured product made chiefly of nitrile rubber, rayon and nylon. For plant cleaning where a chamois will do a better job than rags, this new product is the answer. Milwaukee Dustless Brush Co.

Circle E33 green card, last page

Brochure Catalogs Over 200 Research Compounds

A new brochure which catalogs more than 200 metallic-organic compounds available from the company's Research Chemical department has been released.

The brochure categorizes the compounds by main constituent elements (e.g. aluminum, antimony, boron) and provides convenient reference data on their physical constants, standard packaging, and prices.

A section is also devoted to those chemicals manufactured in commercial quantities. Specifications and principal uses are listed. Anderson Chemical Co., division of Stauffer Chemical Co.

Circle E34 green card, last page

API Catalogue Describes Publications Available

The 1959 catalogue of publications and materials produced by API is available through the New York headquarters.

It contains thumbnail descriptions of each publication, code numbers and costs, and specific instructions for ordering the various items. Copies of the 60-page catalogue may be obtained gratis. American Petroleum Institute.

Circle E35 green card, last page

Isobutylene "Family Tree" Covers Reported Reactions

What is believed to be the first comprehensive isobutylene "family tree," graphically showing present commercial uses and all reported reactions having potential new-product significance has been issued. Accompanying this 17 x 22

Photo courtesy Standard Oil Co. (New Jersey)

LOOKING FOR MORE HEAT

FROM THE FUEL YOU'RE NOW USING?

AN AIR PREHEATER CAN PUT AN EXTRA 1000° INTO YOUR FURNACE

You can get more heat – from the same amounts of your regular fuel – with a Ljungstrom® Air Preheater. An Air Preheater can recover as much as 1000°F from the exhaust of stills or boilers and return it to the combustion air of any kind of fuel-burning equipment. Extra furnace efficiency will in turn permit use of advanced boiler designs, finer controls and a more uniform, more profitable product.

You save fuel with preheated air, too. Even if you recover only 45°F from stack gas, you'll save 1% of your fuel bill. Recover 1000°F, and you can maintain present operating temperatures *on 20% less fuel.*

There's also less maintenance on a Ljungstrom-equipped furnace. Fuel burns more completely in preheated air, so there's less slag, fewer deposits, higher availability of equipment. What you save on maintenance and fuel alone will pay for your Air Preheater in two years or less. "Write-off" can be cut to *as little as nine months* if you use the extra capacity of a preheated furnace to boost product quality.

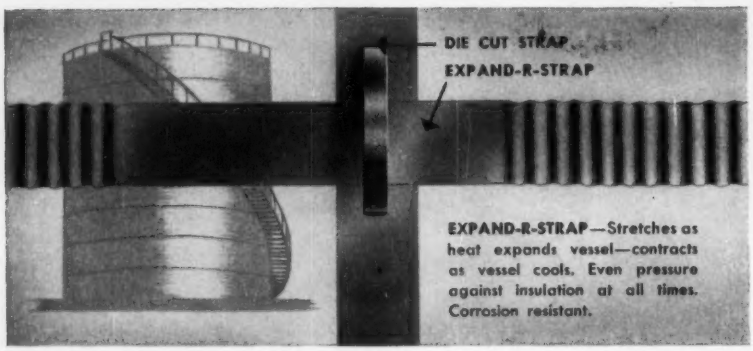
Free facts on fuel savings

One company's fuel savings with an Air Preheater are factually described in an article by Oliver F. Campbell. Write today for your free copy.

THE AIR PREHEATER CORPORATION

60 East 42nd Street, New York 17, N. Y.

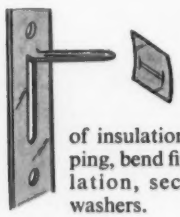
NOW! One source for ALL your strapping needs


DIE CUT STRAP
EXPAND-R-STRAP
EXPAND-R-STRAP—Stretches as heat expands vessel—contracts as vessel cools. Even pressure against insulation at all times. Corrosion resistant.

ALLOY STRAPPING
For all types of insulation and varying corrosive conditions.

TENSIONING TOOLS
A full range of highest quality—easiest to use strapping tools.

ALLOY SEALS
Stainless steel, aluminum, galvanized, brass and monel seals for all widths and sizes of strapping.



FINGER STRAPPING
For all thicknesses and types of insulation. Apply as strapping, bend fingers, impale insulation, secure with spring washers.

WIRE—STAPLES & PINS
Available in all alloy grades.

SPACERS & CLAMPS

Especially designed for steam tracer lines.

A.J. GERRARD AND COMPANY
1956 Hawthorne Court • MELROSE PARK, ILLINOIS

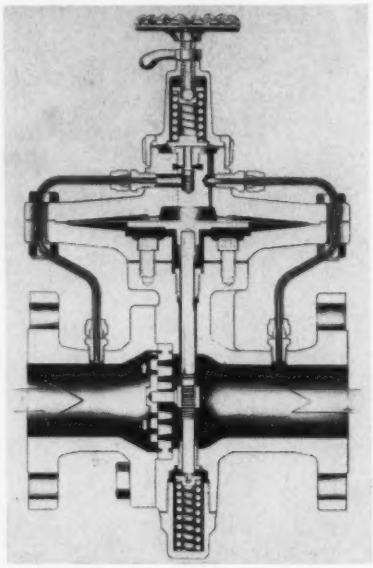
☐ INSULATION CONTRACTORS—SEND FOR THIS 52 PAGE INSULATION MANUAL
☐ SEND DETAILS ON FOLLOWING PRODUCTS: _____

COMPANY _____
NAME _____ TITLE _____
ADDRESS _____
CITY _____ ZONE _____ STATE _____

inch chart is a bibliography of 213 literature references, keyed to the chart to facilitate the exploratory work of research and product-development men.

Petro-Tex Chemical Corp. has recently come on stream with the first major, non-captive production of 99+ percent Isobutylene. The new output is currently moving into non-rubber uses, but Petro-Tex believes there is a broad spectrum of new uses for this comparatively unexploited reactive olefin now that it is commercially available in ample supply at an attractive price. Petro-Tex Chemical Corp.

Circle E36 green card, last page



Straight Flow Gives Low Turbulence In New PRV

An all-new, pilot-operated pressure reducing valve, incorporating a patented sliding gate and plate main valve, is now available. It features an integral pilot with filter screen, oversize, clog-resistant passages, and a ball bearing adjusting screw with handwheel. Its short stroke with metal seats and metal diaphragms give a long life with minimum maintenance. Straight through flow gives a low turbulence through the main valve for accurate regulation. Tight shut off is achieved with self-lapping seats. Jordan Industrial Sales division, OPW Corp.

Circle E37 green card, last page

Chromatography Articles Abstracted On Punch Cards

In order to keep analysts and technologists informed on current developments in gas chromatography, a specialized abstracting service has been organized.

Each new article on gas chromatography is abstracted immediately after publication and the abstracts are sent to subscribers on 5 x 8-inch Unisort Analysis (punched) Cards. Every journal of significance is searched to insure com-

POSEY PRESSURE VESSELS

These twin tanks were designed for propane storage for a South American industry. Each tank is 34′ long and 10′ in diameter. Fabricated from 1″ steel plate, these tanks operate at pressures up to 250 pounds per square inch.

POSEY pressure vessels are in service in most civilized parts of the globe. With almost a half-century of experience, we are well equipped to design, fabricate and erect pressure vessels of all types and sizes . . . of steel or alloy steel . . . for liquid or gas.

Every pressure vessel is tested to considerable excess over normal working pressures. All standard codes are met, including ASME, API-ASME and API.

Let us quote on your next pressure vessel job. Quotations and other information upon request without any obligation.

POSEY IRON WORKS, INC.
STEEL PLATE DIVISION **LANCASTER, PENNA.**
New York Office: Graybar Building
Established 1910

DIVISIONS: *Steel Plate Fabrication ● Brick Machinery and Mixers ● Industrial Heating ● Iroquois Asphalt Plant ● Gray Iron and Steel Foundry ● Tunnel and Mine Equipment*

Your
STRUCTURAL STEEL and STEEL PLATE FABRICATION
ON TIME!

We pride ourselves for "on time" delivery. Thoroughly experienced staff of designers, engineers, and fabricators, to furnish the steel you want, when you want it. AISC members. ASME pressure vessels, tanks, heat exchangers, as well as structural steel. Location served by SP and MP railroads, and our dock is on the Intracoastal Waterway. Write, wire or phone for FACT FILE on our complete facilities.

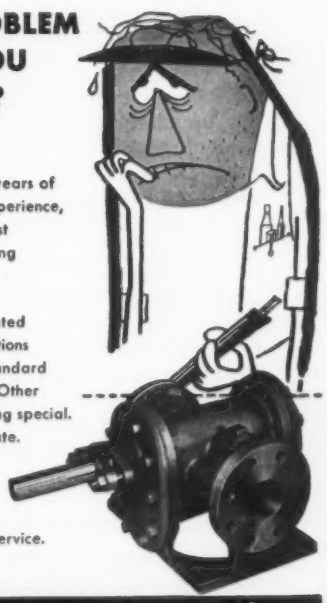
ST. MARY IRON WORKS, INC.

Steel Fabricators for over Half a Century
FRANKLIN, LOUISIANA PHONE 820

PUMPING PROBLEM GIVING YOU TROUBLE?

Get *qualified* help.
Tell us about it.
SK Gear Pumps, product of years of research and engineering experience, are solving problems in almost every industrial field—pumping many types of materials like alcohol, fuel oils, glue, wax, lube oils, resins, cellulose, heated oils, road tars. Some applications require only a top-quality standard pump. Ours are top-quality. Other applications demand something special. If so, we're ready to cooperate.

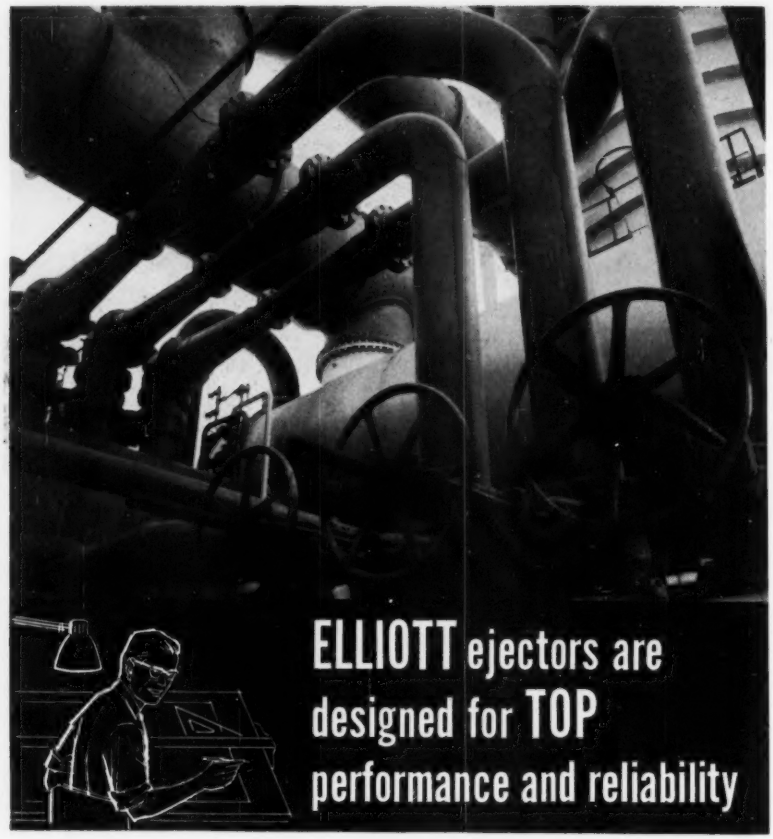
We'd like to get acquainted —let us send you Bulletin 17-A describing our pumps and engineering service. Just write us. We'll send it.



Schutte and Koerting COMPANY
MANUFACTURING ENGINEERS
2257 STATE ROAD, CORNWELLS HEIGHTS, BUCKS COUNTY, PA.

Jet Apparatus: Ask for Condensed Bulletin J-1.	Rotameters & Flow Indicators: Ask for Condensed Bulletin 18-RA.	Valves: Ask for Condensed Bulletin V-1.	Heat Transfer Apparatus: Ask for Condensed Bulletin HT-1.	Gear Pumps: Ask for Bulletin 17-A

For more data on advertised products, use Readers' Service Cards, last page.



. . . engineered and built to meet your requirements

An unusual example of Elliott's engineering experience in designing and building steam jet ejectors and auxiliary equipment for producing vacuum is seen above. This photo shows the three first-stage ejectors of an Elliott triple element two-stage unit which serves a residuum stripper in a California oil refinery.

The vapor load from this vacuum flash unit adds up to approximately 57,000 lb per hr of steam, condensable hydrocarbon vapor and noncondensable gas. To handle this load efficiently and economically requires maintaining approximately 2 in. Hg absolute pressure *continuously*. Two Elliott 11,000-sq ft surface condensers are used, arranged in parallel, and the Elliott triple, two-stage ejector which serves these condensers is discharged to an intercondenser and an aftercondenser combined in a common shell.

wide range of single-stage and multistage types

of Elliott steam jet ejectors is available for maintaining low absolute pressures in refineries, chemical plants and other processing industries. For complete data or engineering assistance, call the Elliott ejector specialist at your nearby Elliott District Office, or write Elliott Company, Jeannette, Pa.

ELLIOTT Company

GB-1

Equipment

prehensive coverage. Programs of technical meetings are reviewed and preprints of all papers on gas chromatography are requested. Abstracts of these papers are issued immediately after their presentation.

These punched cards may be notched for classification purposes by the user. A suggested system of classification is sent to each subscriber, which can be adapted into a filing system suited to his specific requirements.

The abstracting is done by chemists having advanced degrees who are proficient in the translation of most of the European languages. The abstractors have professional library experience and expert guidance in gas chromatography. Charles Doak Lowry, Jr.

Circle E38 green card, last page

152-Page Power Cable Manual Is Available

A new, 152-page, solid type paper-insulated power cable manual has just been issued.

This complete book is liberally illustrated with photographs, charts and diagrams. It is divided into five basic sections, all of which are completely and clearly indexed.

Section one, Basic Designs and Applications, gives detailed information about the three basic designs of solid type paper cable: three conductor, shielded (Type H); three conductor, belted; and single conductor. Construction compo-

If You Want

Fast

Results . . . Use

Petroleum

Refiner

Classified Ads

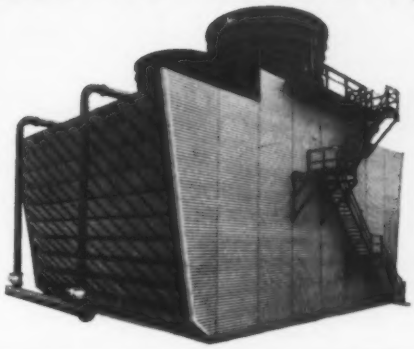
They don't cost,

they pay.

1958 TOWER TESTS

Marley's 3rd Annual Report to Industry

The day of "hazard buying" of cooling towers is past. To substantiate this, Marley encourages purchasers to TEST YOUR TOWER and each year publishes the results of these tests. This list of tests is not selected or edited—it is a consecutive record of ALL tests of Marley Cross-Flow towers during 1958. Seventeen tests were conducted according to accepted test code procedure—*more than reported by all other manufacturers combined.*



TEST NO.	TYPE OF SERVICE AND LOCATION	SPECIFIED CONDITIONS				TEST RESULTS	
		Gallons Per Minute	Hot Water Temp.	Cold Water Temp.	Wet Bulb Temp.	Degrees Cold Water Temp.	Percent Capacity
1*	Petroleum Refinery—North Central	5,200	120°	84°	74°	+0.44°	+3.5%
2*	Chemical Process—Mountain States	7,000	90°	75°	65°	+0.65°	+7.2%
3*	Power Plant—West Coast	31,500	109.4°	91°	80°	+0.35°	+2.6%
4†	Petroleum Refinery—Gulf Coast	28,000	113°	93°	82.5°	+0.37°	+2.9%
5†	Petroleum Refinery—Gulf Coast	16,000	112°	91.5°	82.5°	+1.50°	+9.6%
6*	Power Plant—Mid-Central	14,750	102°	87°	75°	+0.40°	+3.1%
7	Petroleum Refinery—Gulf Coast	25,000	120°	95°	82.5°	−0.30°	−2.0%
8†	Power Plant—Mid-Central	7,000	96°	85°	75°	−0.05°	−0.5%
9*	Petroleum Refinery—North-Central	9,300	110°	84°	74°	+0.40°	+3.0%
10	Power Plant—Mid-Central	9,500	100°	86°	75°	+0.10°	+0.8%
11†	Power Plant—Mid-Central	16,000	102.2°	90°	75°	+0.30°	+2.0%
12†	Petroleum Refinery—Mid-Central	23,250	106.5°	88.5°	77°	+1.60°	+12.6%
13	Power Plant—Mid-Central	60,000	99°	84°	74°	+0.30°	+3.1%
14†	Petroleum Refinery—Gulf Coast	45,000	112°	89°	82.5°	−0.54°	−5.2%
15	Petroleum Refinery—Gulf Coast	6,000	115°	85°	79°	+0.30°	+3.6%
16	Air Conditioning—Mid-Central	4,200	96°	85°	78°	+0.30°	+3.5%
17*	Power Plant—Mid-Central	44,000	99.5°	86°	74°	+0.80°	+7.2%
18†	Power Plant—Southwest	61,500	106.5°	88.5°	76.5°	+1.20°	+11.0%
19*	Petroleum Refinery—East-Central	8,000	115°	85°	75°	+0.50°	+4.0%
20†	Petroleum Refinery—Gulf Coast	57,500	120°	85°	79°	−0.03°	−0.03%
21	Petroleum Refinery—Gulf Coast	18,830	112°	85°	79°	+0.14°	+1.5%
22†	Petroleum Refinery—Gulf Coast	34,000	113.5°	87.5°	80°	+0.12°	+1.2%

*Code Test (observer not present) †Code Test (observer present)

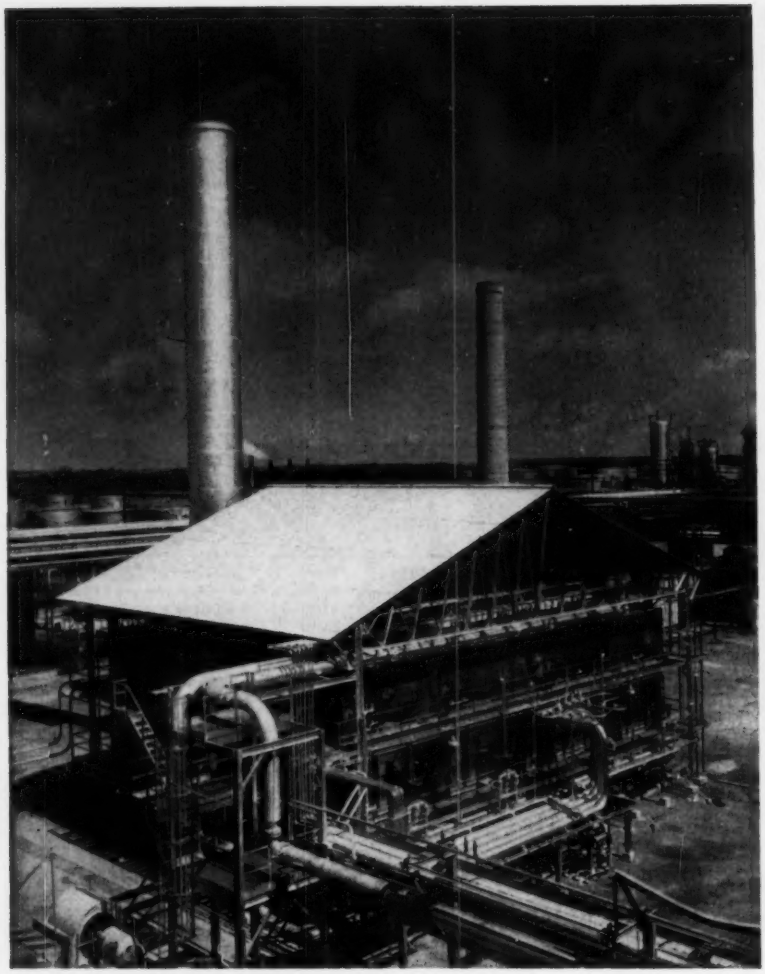
Here is positive proof of "in service" performance—the strongest possible assurance that Marley towers are bid and built to equal or exceed specified performance. If you believe with Marley that every industrial tower owner is entitled—if not obligated—to know the capability of his tower, before and after installation, write today for these Marley technical bulletins: "Analyze Your Bids" and "Test Your Tower."

MARLEY

The Marley Company

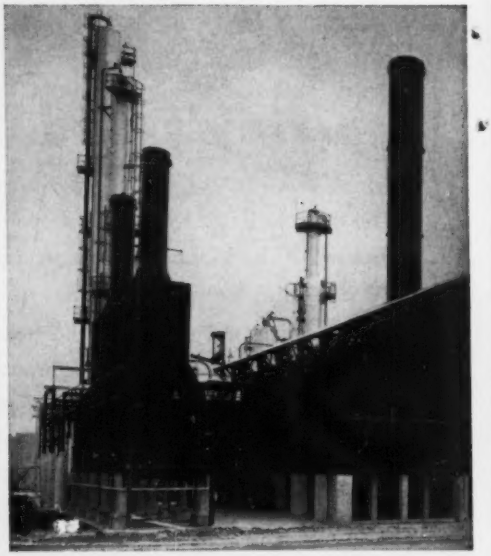
Kansas City, Missouri

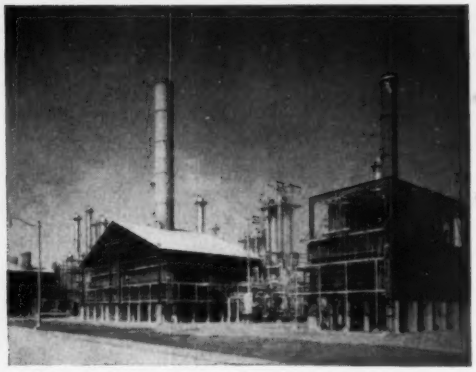
For more data on advertised products, use Readers' Service Cards, last page.



Portable crude heater for Magnolia Petroleum Company, Beaumont, Texas.

Ultraformer heater for American Oil Co. at El Dorado, Arkansas.





Platformer and desulphurizer heaters for Shell Oil Co. at Deer Park, Houston, Texas.

HIGHER EFFICIENCY, LUMMUS OIL HEATERS

Lummus designs horizontal and vertical-tube oil heaters to any size, for any process—anywhere in the world

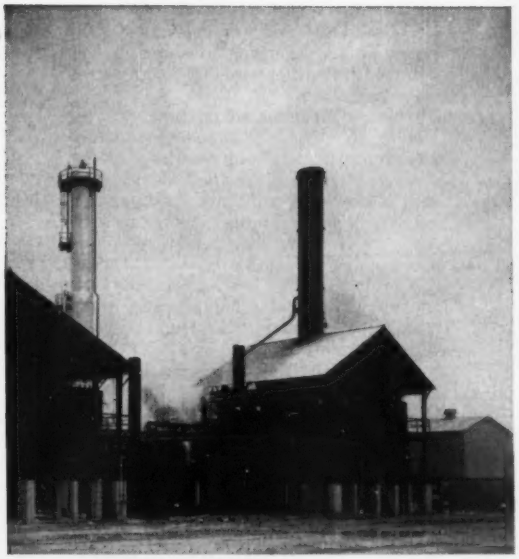
Major refiners confidently turn to Lummus on their important and difficult oil heater jobs.

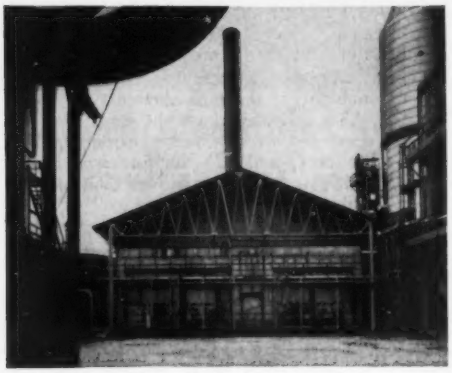
In the last 25 years, the combined capacity of all Lummus oil heaters built has exceeded that of any other company in the world. The reasons: greater durability, more efficient operation, an absolute minimum of days lost to downtime.

Major refiners maintain large engineering and economics staffs who can evaluate the performance of important heating equipment. They buy more Lummus oil heaters because they *know* through statistical comparison that Lummus gives them *more heater per dollar.*

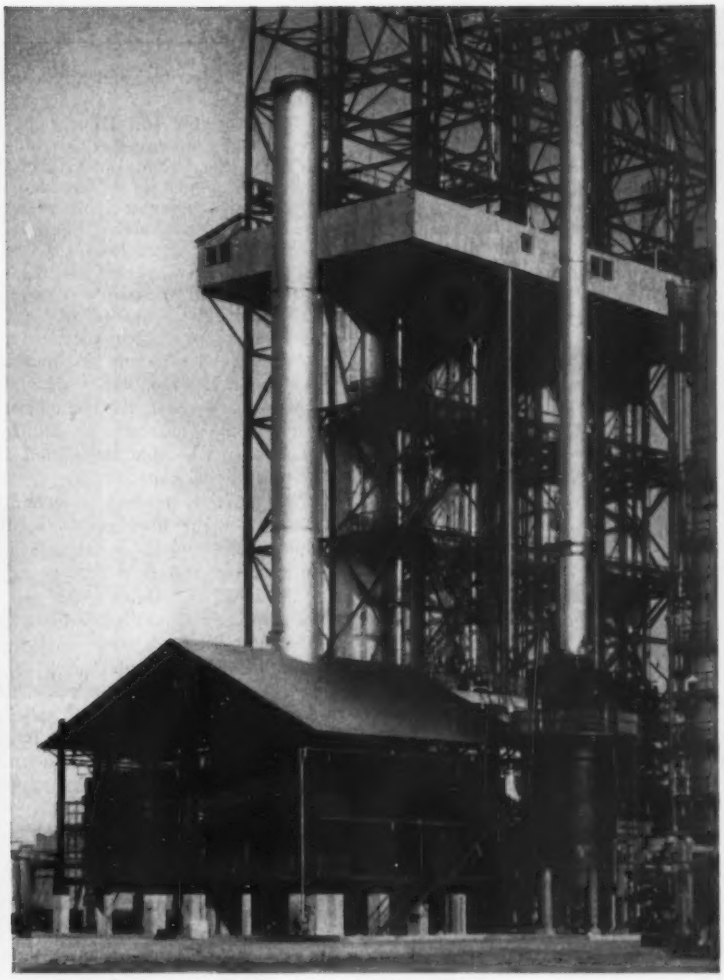
Lummus offers over a quarter of a century of oil heater experience for petroleum refineries, chemical and petrochemical plants. The highly trained engineering staff of the Oil Heater Division is ready in the Lummus New York office to give each job the full benefit of its accumulated know-how in this field.

Lummus oil heaters, of both special and standard design, range from 100,000 to 300,000,000 Btu per hour. As illustrated above, neither size, type nor location of the unit presents a problem to Lummus. Because Lummus offers *every* type of oil heater, you can be sure that we will recommend the *right*





Crude heater for Socony Mobil at Paulsboro, N. J.



Delayed coker heater for the American Oil Co. at Yorktown, Virginia.

MINIMUM DOWNTIME MAKE PREFERRED AMONG MAJOR REFINERS

unit for your needs. Complete Lummus facilities are available world-wide through any of the five international Lummus companies. Equipment is designed in New York, procurement is made through the nearest Lummus international office, and the cost of the job is payable in the currency of the country in which the procurement is handled!

Consult with Lummus on your next oil heater – large or small.

Visit the Lummus Exhibit—Fifth World Petroleum Congress Exposition, the New York Coliseum, June 1-5, 1959

LUMMUS

THE LUMMUS COMPANY, OIL HEATER DIVISION
385 MADISON AVENUE, NEW YORK 17, N. Y.

WASHINGTON, D. C. • HOUSTON • MONTREAL • MARACAIBO • LONDON • PARIS • THE HAGUE

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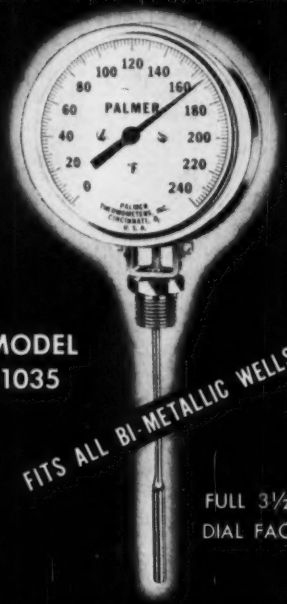
Outstanding Accuracy

PALMER

Dial Thermometer



Check these functional features

- Direct-drive Bourdon Coil with a filled system for longer lasting accuracy.
- Stem can be placed at any desired angle and case can be rotated to most readable position.
- External calibration for zero setting.
- Unaffected by stem alignment.
- Accurate to one scale division.
- No sticking at any temperature.
- Non-corrosive case.

PALMER

THERMOMETERS, INC.

Mfrs. of Industrial Laboratory, Recording and Dial Thermometers

2515 Norwood Ave., Cincinnati 12, O.

Equipment

nents are described and applications are given.

The Weights and Dimensions section is arranged in easy-to-read table form. It gives the weights and dimensions of conductors alone, as well as for the three basic cable designs. This section also contains a new catalog numbering system for all constructions.

The section on Formulas, Tables and Technical Information is complete and thorough. There are easy-to-read tables of current carrying capacity for one, two and three conductors in underground ducts, in air, in conduit in air, and direct burial. Portions of this section deal with short circuit currents, grounding cable characteristics, cable installation calculations and reel capacities.

A section is devoted to recommended installation practices for ducts and conduit, direct burial, aerial, splicing and terminating and field testing.

Section five contains splice and termination drawings and instructions. Recommended procedures are given for making straight, wye and trifurcating splices as well as pothead terminations. This section also contains general splicing information such as lead sleeve dimensions, filling compound quantities, stepping instructions and connector size equivalents. The Okonite Co.

Circle E39 green card, last page

Density Gauge Checks Process Stream Quality

On-the-line density gauge has a good potential for checking the quality on volume streams in refineries and petrochemical plants.

The gauge, mounted on pipes or vessels to 36 inches in diameter, provides continuous reading and recording of the density of process streams. Using radiated nuclear energy from a sealed source, not touching the product, the gauge can read the density, record and automatically control it.

The unit may be located remotely and provides long-term reliability and minimum maintenance. Electronics Div., Curtiss-Wright Corp.

Circle E40 green card, last page

Heating of Viscous Fluids Described In Bulletin

A new eight-page bulletin gives complete specifications and description of the company's fuel oil heaters used on the suction side of pumps for heating extremely viscous fluids, such as Bunker C Fuel oils, asphalt, etc., in order to reduce their viscosities so they can be more readily pumped.

The two principal types catalogued include (1) the tank suction type heater which is installed on the tank with the open end of the heater extending into the tank, and (2) the line type heater which is mounted entirely outside the tank in the pipeline.

Information given covers data on the

PREVENT wet gas problems at low cost

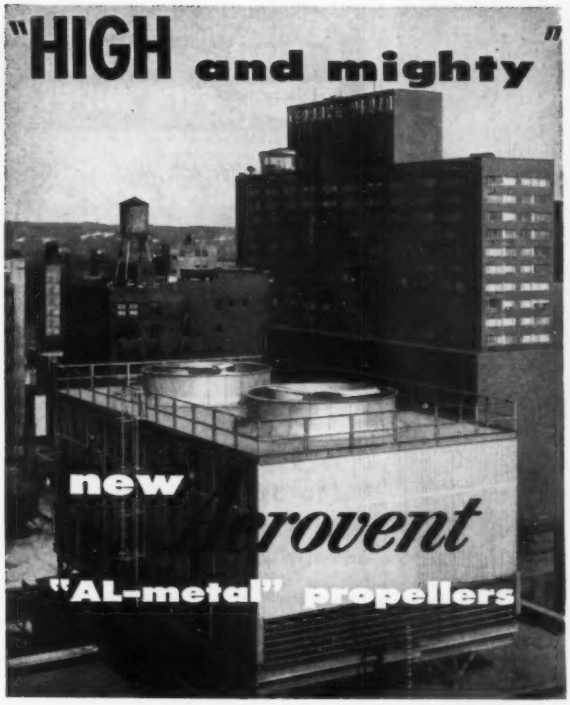
with PRITCHARD "Packaged" HYDRYER

Dries gas or compressed air to prevent equipment shutdown, ice formation and line blockage. Operates continuously at full line pressure. Reduces dew points as low as −100°F. Factory-fabricated and shipped ready for hook-up. Saves cost of expensive field fabrication and custom engineering. Sizes to 50,000 scfm.

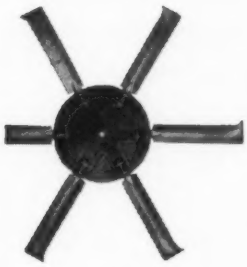
FREE BULLETIN—Gives application details, selection tables. Write for copy

J. F. Pritchard & co.
OF CALIFORNIA

Dept. 129, 4625 Roanoke Parkway, Kansas City 12, Mo.



move mountains - of AIR!
in towers and exchangers



Developed originally for the petroleum industry, Aerovent Large-Diameter "Al-metal" Propellers, constructed of tough, durable aluminum alloy, move great quantities of air at high velocities, in heat exchangers and cooling towers. Pictured above are two 4-blade, 16-ft. propellers in a cooling tower installation. These mighty propellers, with adjustable-pitch "Macheta" Airfoil blades, are job-engineered to individual specifications.

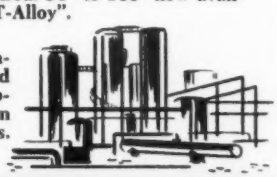
Write for free Bulletin 510

- Sizes 14' to 18'
- 4 or 6 blades

DESIGNED FOR DEPENDABLE OPERATION!

Endurance tests, conducted at *3 times* normal loading prove the ability of these new large-diameter propellers to withstand severe punishment. Heavy-duty cast steel hubs offer maximum resistance to stresses. Angle settings for each operating requirement, and appropriate alternate settings, assure accurate pitch for any predetermined performance which may be required. 54" to 144" now available in revolutionary new "T-Alloy".

REFINERIES, pumping stations, industrial plants and commercial buildings use Aerovent "Al-metal" Propellers in major air-moving applications.



Aerovent FAN COMPANY, INC.
LARGE PROPELLER DIVISION
304 Wright Bldg.
TULSA 3, OKLA.
Main Office and Factory
PIQUA, OHIO

A sleeve, raised and lowered within a non-magnetic tube, attracts or releases an Alnico magnet attached to a mercury switch. Basically, this is Magnetrol.

As SIMPLE and Dependable as the Pull of a MAGNET!

MAGNETROL

The Simplest, Most Versatile LIQUID LEVEL CONTROL Ever Devised!

Linked to liquid level by infallible magnetic force, Magnetrol is free from the limitations inherent in mechanical or electrical controls. With the actuating magnet rated at 98% of initial strength after 30 years, Magnetrol has *infinite operating life*, with practically no maintenance at all. There are no wearing parts to get out of order.

What's more, Magnetrol's simple operating principle permits easy, economical modification of standard units to meet *any* pressure, temperature or corrosion requirements. That's why there's practically no limit to Magnetrol's use. It's also why "specials" are likely to be standard with us. Magnetrol units control level changes from .0025-in. to 150-ft. —with single or multi-stage switching.

MAGNETROL, Inc.

● SEND COUPON FOR DETAILS

MAGNETROL, Inc. 2112 S. Marshall Blvd., Chicago 23, Illinois
Please send me catalog data and full information on Magnetrol Liquid Level Controls.

Name_____
Company_____
Address_____
Zone_____ State_____

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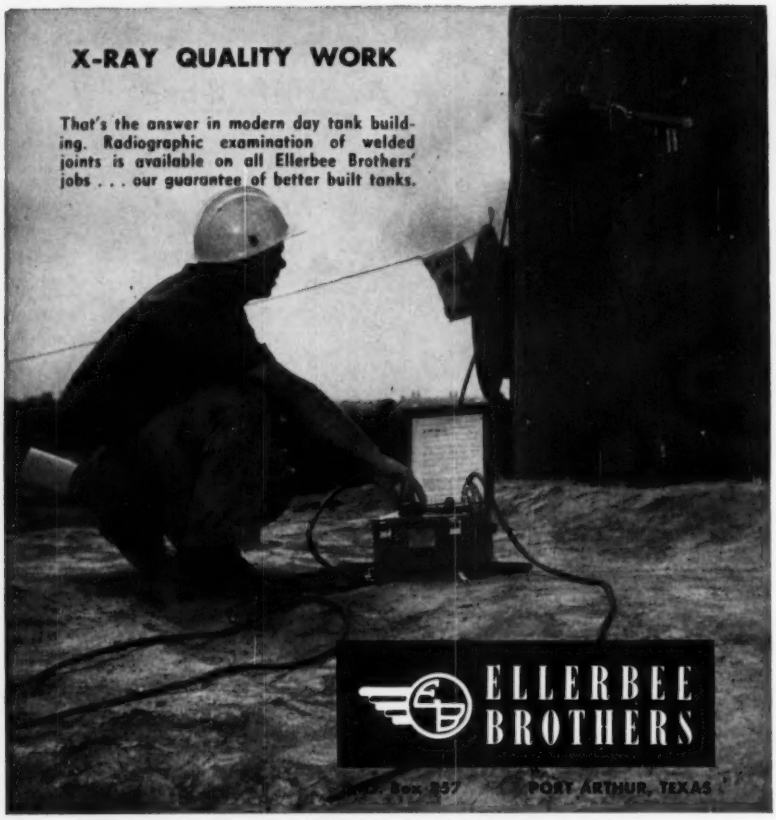

X-RAY QUALITY WORK
That's the answer in modern day tank building. Radiographic examination of welded joints is available on all Ellerbee Brothers' jobs . . . our guarantee of better built tanks.
ELLERBEE BROTHERS
P.O. Box 837
PORT ARTHUR, TEXAS

NPW Packaged PIPE NIPPLES

Famous for fast complete shipments

SEAMLESS STEEL NIPPLES

FROM STOCK:

2" to 8" Standard and Extra Strong Black in A.S.T.M. A-53 Grade "A."

TO ORDER:

2" to 8" Double Extra Strong Black in A.S.T.M. A-53 Grade "A."

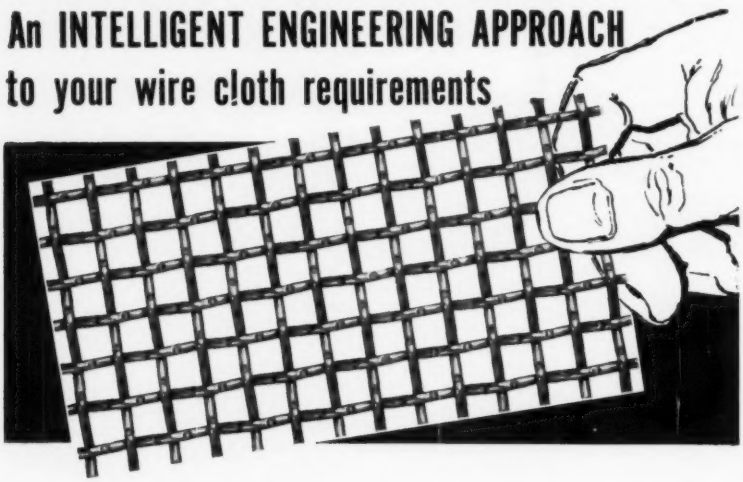
2" to 4" Standard and Extra Strong Black in A.S.T.M. A-106 Grade "A" Galvanized and Grade "B" nipples.

- *Avoid errors. Nipples are marked "SMLS" with Grade, Weight and A.S.T.M. Spec.*

ID-4

Pittsburgh NIPPLE WORKS, Inc.
1455 SPRING GARDEN AVE., PITTSBURGH 12, PA.

An INTELLIGENT ENGINEERING APPROACH to your wire cloth requirements



An intelligent engineering approach to wire cloth and screen requirements pays dividends. Cleveland Wire Cloth, knowing alloy, tolerances, openings, crimping and tightness of weave, study the materials being processed, processing conditions and the end results before specifying any wire cloth. They may select from hundreds of unsurpassed quality cloth in stock, or if necessary, will weave a screen for your needs. Contact Cleveland today for an intelligent engineering approach to your wire cloth and fabricated screen problems. Ask for Bulletin No. 10.

SEE OUR AD IN REFINERY CATALOG

THE CLEVELAND WIRE CLOTH & MFG. CO.
3571 EAST 78th STREET, CLEVELAND 6, OHIO • DI 1-1832

REFRACTORY HAYDITE

Makes Higher Heat Resistant Concrete

Haydite aggregate used with Lumnite cement produces refractory concrete suitable for sustained temperatures up to 1800-2000° F., which makes it excellent for tubular heaters, ducts, flues, stacks and catalytic crackers. Weighing from 30 to 40 per cent less than ordinary aggregate concrete, Haydite is exceedingly strong. It has excellent insulating properties and withstands pressures of up to 1130 pounds per square inch. Write today for free folder and complete information about Carter-Waters Refractory Haydite.
We sell direct to you.

CONSTRUCTION MATERIALS
CARTER-WATERS
KANSAS CITY MISSOURI
2440 Pennway Phone GRand 1-2570

Dependable
SACHSE ELECTRIC INC.
BATON ROUGE LA.

Brownweld Fintubes which extend the area of heat transfer surface up to 800 percent, tubesheet data, materials and code, pressure and temperature ratings, heater lengths, shell nozzle orientation and nozzle sizes. Brown Fintube Co.

Circle E41 green card, last page

Bulletin Covers Cyclone Recovery of Fluid Catalyst

A new four-page bulletin describes a line of Type SDC Duclones for catalyst recovery and other fluid bed operations, including Fluid Coking, Fluid Hydroforming, Elutriator Towers, Catalyst Disposal and Conveying and all fluid solids operations. The high efficiency cyclones were specially designed for high efficiency, low pressure-loss and long service life under the high temperature and erosive conditions inherent in many fluid bed processes. The Ducon Co., Inc.

Circle E42 green card, last page

Desuperheater Controls Steam Temp To 5 Degrees

A carburetor-type desuperheater capable of being controlled to supply steam at a temperature within ±5 degrees F of plant requirements is described in a new bulletin. It explains how the desuperheater reduces steam superheat to the level required for process work. Also described are structural details, system arrangements of control components, and mechanical specifications. Copes-Vulcan Div., Blaw-Knox Co.

Circle E43 green card, last page

Equipment

Small Computer Does More Than One Job At A Time

A new transistorized medium-scale computer system; so flexible it can do data-processing and scientific computation simultaneously at lighting speeds, has been developed.

Called the Honeywell 800, it establishes several firsts in the art of computer design, the most important being the ability of its small, powerful central processor to independently perform more than one job at a time. This ability, called "Automatic Parallel Processing," is combined with a building-block expansion principle of design promising "unprecedented economies" for growth companies needing versatility in handling current and future paperwork.

Monthly rental will range upwards from $11,000 a month for the minimum system. It will require about one-tenth the floor space required by a comparable nontransistorized system and will use about one-tenth the power.

Other important features are:

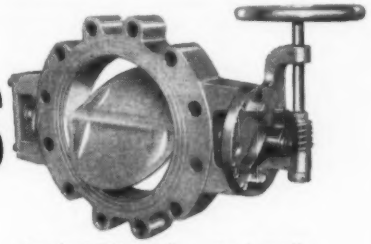
- Being completely transistorized, it will require little air cooling.
- Expanded, it can control scores of peripheral devices, providing direct access to all of them, in addition to the advantages of parallel processing:

Orthotronic Correction, an exclusive data-protection principle which makes it possible to reconstruct lost, damaged

ROCKWELL

"WAFER" VALVES

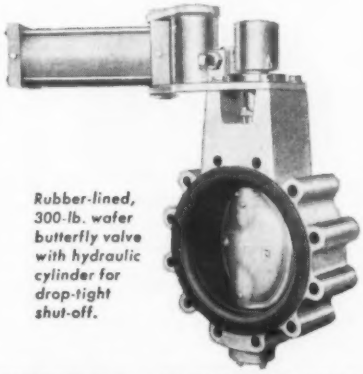
■ LOWER IN FIRST COST
■ NEED MINIMUM SPACE
■ EASY TO OPERATE



Standard 125-150 lb. wafer butterfly valve with handwheel; also available with lever control or mechanical operators.

For controlled throttling or tight shut-off of air, gases, process fluids or semi-solids, Rockwell Wafer Butterfly Valves offer the advantages of rugged construction, compactness, small face-to-face dimension to fit in minimum clearance between pipe flanges.

Write for Bulletin 580.



Rubber-lined, 300-lb. wafer butterfly valve with hydraulic cylinder for drop-tight shut-off.

ROCKWELL SINCE 1888 BUILT

W. S. ROCKWELL COMPANY

Valves - Butterfly · Slide · Diaphragm · Special

2369 ELIOT STREET • FAIRFIELD, CONN.

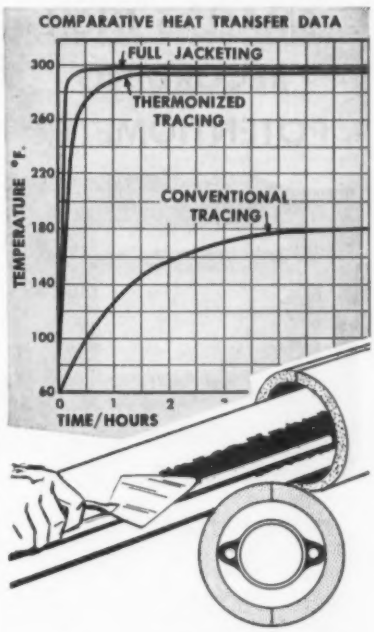
HAVE YOU TRIED

? THERMON ?

Thoroughly proved

HEAT TRANSFER MEDIUM

now effecting savings up to 90% for over 700 users!



Thermon is a non-metallic plastic compound with highly efficient heat transfer properties, and is easily applied over either steam traced or electrical resistance systems . . . working equally well for either heating or cooling processes.

Thermonizing has excellent heat transfer characteristics (see curves), exceeding steam traced equipment approximately 1100%, and closely approaching jacketing equipment. Thermon can be used almost without exception in place of expensive jacketing (and in many applications where jacketing is impossible), with savings up to 90%.

Write for complete technical literature on revolutionary Thermon!

THERMON

THERMON MANUFACTURING CO.

1817 Rosine • P. O. Box 1961
Houston, Texas

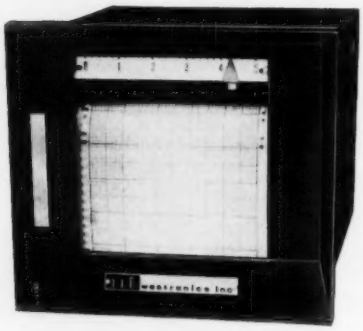
101

GAS CHROMATOGRAPHY

A CHOICE APPLICATION FOR

westronics'

SMALL - 5 INCH RECORDING POTENTIOMETER



offering

MIN. SPAN 0-1 MV.
PEN SPEED 1 SEC.

EXCELLENT HUM REJECTION

PLUS

Many optional features usually found only in large recording instruments occupying *4 TIMES* the panel space.

ALSO

AVAILABLE WITH 2 *PENS* BOTH RECORDING FULL SCALE.

wi westronics® INCORPORATED

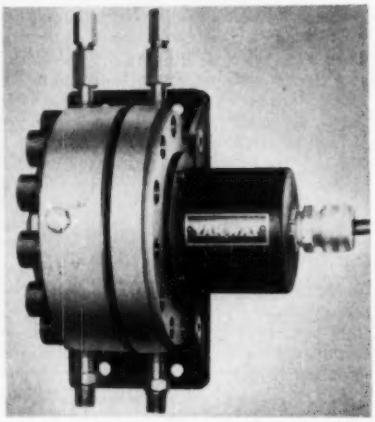
3605 McCART
FORT WORTH, TEXAS

Equipment

or garbled data instantly and automatically, is standard equipment. The system also incorporates an extensive checking network, including double-reading of all source data, parity checks within each word and record to permit verification of accuracy whenever information is transferred within the system, and other refinements of accuracy verification.

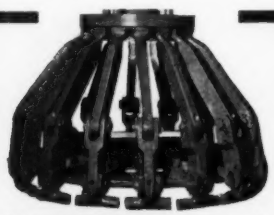
As a scientific computer, the system combines high internal speeds and large memory capacity (up to 16,384 words), with both binary and decimal arithmetic. Floating point arithmetic is available as an option. Minneapolis-Honeywell Regulator Co.

Circle E44 green card, last page



Pressure Variations Sensed By Remote Transmitter

The remarkable success of the company's Remote Liquid Level Indicator has led to the development of a similar instrument operating without visual indication, and controlling a distant indicator, controller, or other electrically-operated receiving instrument. This new product is the Yarway Differential Pressure Transmitter.



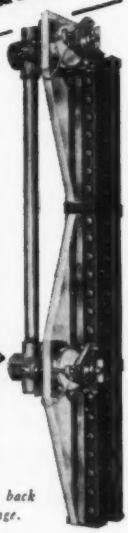
BARRETT automatic
Filling and Crimping Equipment
for handling greases and other viscous fluids.
- No operator required.
- 100% air operated.

Fills, seals, stamps and counts lug cover pails. Output of 15 pails per minute. Write for details on installation to meet your requirements.

BARRETT
Manufacturing Co.
P. O. Box 8096, Houston 4, Texas

New Improved JERGUSON Gage Illuminator

gives up to 3 times the illumination



Low cost explosion-proof lighting of entire gage glass with no glare or blind spots

New Features:

Simplified Relamping . . . loosen one thumb screw to lift out cover and glass housing in one piece.

New Safety Chain prevents accidental dropping.

Now both UL and CSA Approved.

Easily mounted on back of Transparent Gage.

The New Jerguson EPL-56 Illuminator gives three times the illumination (and 3 times the bulb life) . . . a bright, evenly diffused light over the entire length of gage glass, thus enabling you to see the liquid level clearly and easily under all conditions. Relamping is simplified: one turn of the thumb screw and you lift out cover and glass housing in one piece.

Jerguson Illuminators incorporate the principle of solid wedge lighting. Illumination from a single bulb is reflected from the angular surface of the plastic wedge and is evenly diffused through the transparent gage glass.

Jerguson Illuminators are UL approved and are built in accordance with their Standard for Electric Lighting Fixtures for use in hazardous locations for Class 1, Group D Services. They are made in a variety of sizes.

Write for Data Unit on Process Gage Illuminators.

JERGUSON
Gages and Valves for the Observation of Liquids and Levels
JERGUSON GAGE & VALVE COMPANY
100 Adams Street, Burlington, Mass.
Offices in Major Cities
Jerguson Tress Gage & Valve Co., Ltd., London, Eng.
Pétrole Service, Paris, France

For Dependable GASKETS
Specify CHICAGO-WILCOX

RING GASKETS
For ring-type flanged joints in high pressure lines. Made of soft iron, standard steel alloys or any non-ferrous metal to any desired cross section. Ask for Bulletin 563.

HEAT EXCHANGER GASKETS

Made in any size or shape needed in double-jacket type. Also cut from solid metal or sheet packing. Ask for Bulletin 564.

CORRUGATED METAL GASKETS
Plain or jacketed type. Made of ingot iron, aluminum, stainless steel, copper, brass, nickel and monel in all sizes and shapes. Ask for Bulletin 565.

Prompt Deliveries

7719 S. Avalon
Chicago 19, Ill.

CHICAGO-WILCOX MFG. CO.

For Immediate Service
PHONE MAIN 6-3712

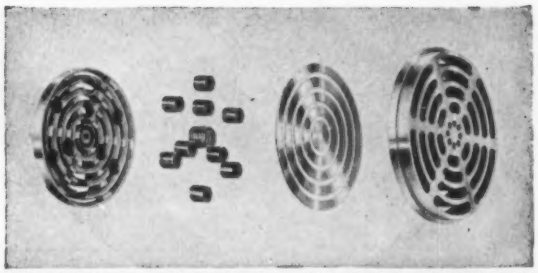
BLINDS • SPACER RINGS • TEMPORARY and LINE STRAINERS • PIVOT FLANGES

SPECTACLE BLIND

EST. SANDUSKY 1901
MAC-IRON
OHIO

The MACK IRON WORKS COMPANY
121 WARREN STREET
WRITE TODAY FOR CATALOG A-9

VOSS VALVES
in your machine mean



LESS MAINTENANCE, FEWER SHUTDOWNS
for your compressor. (air, gas, ammonia)

- **up to 40% more valve area • minimum pressure loss • higher efficiency**
- **less power consumption • normal discharge temperature**
- **quiet, vibration-free • utmost safety • lower operating costs**

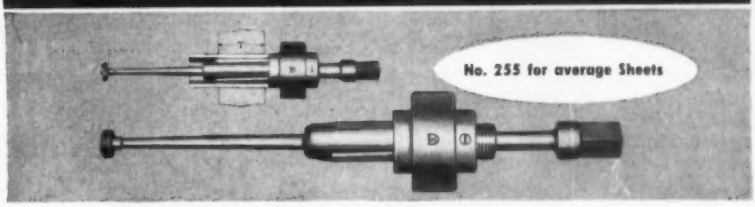
VOSS VALVES are made to specification, machined from solid stock (not cast)—using best alloy steels; for corrosion condition—stainless steels, such as 410, 18-8 or non-ferrous alloys—monel, inconel, etc. PLATES are machined (not stamped) and ground for precise close tolerance fit; are dimensionally stable . . . ductile . . . resist fracture, high temperatures and corrosion . . . withstand fatigue. SPRINGS of heavy rectangular sections and large diameters, add to dependability and safety.

Our detailed proposal will be sent without obligation. Send name, bore, stroke and speed of machine.

VOSS VALVES REG. U.S. PAT. OFF.
J. H. H. VOSS Co., Inc.
785 East 144th Street, New York 54, N. Y.

IDEAL WIEDEKE • BATTON TUBE EXPANDERS

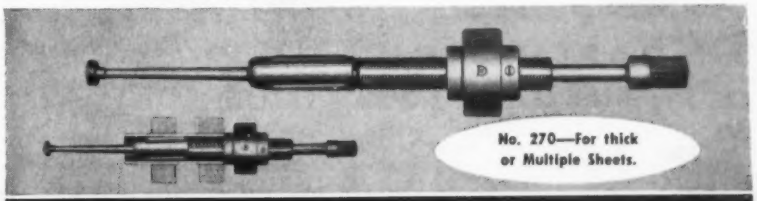
WIEDEKE Precision-Built Tube Expanders



Ball Bearing Adjustable Thrust Collar Tube Expanders are made for Tubes ¼" diameter and larger.
Recommended for use with any Controlled Rolling Motor for uniform expansion of Tubes.

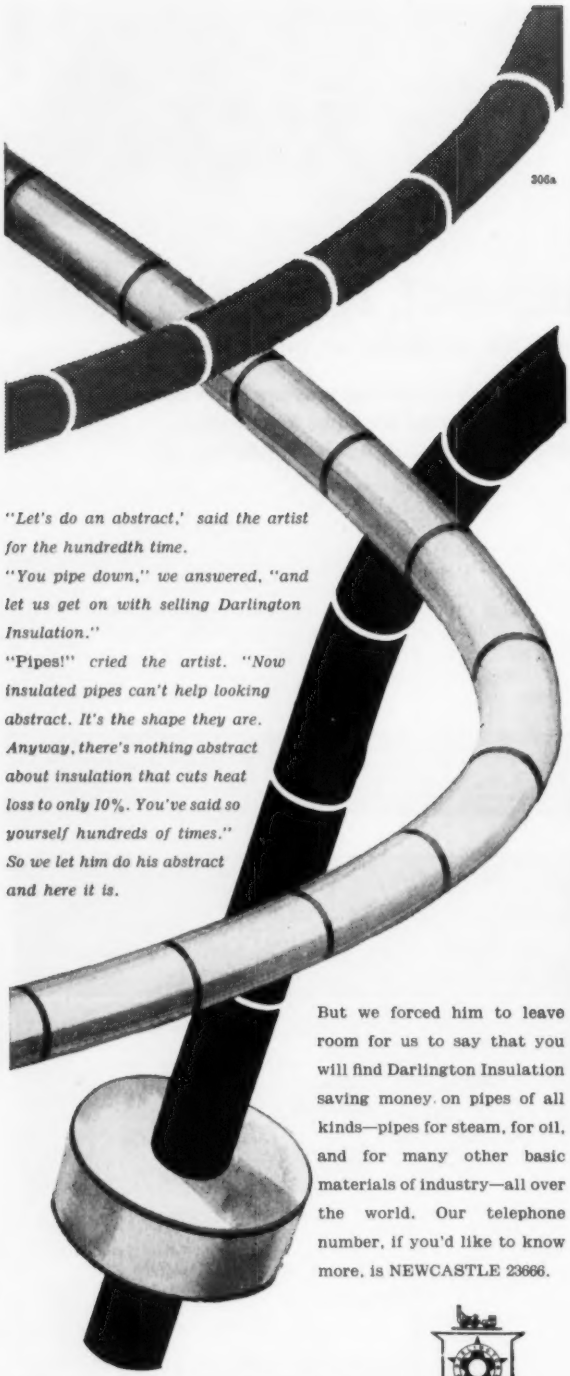
See your Dealer or write us for Bulletin.

For Rolling—Heat Exchanger, Condenser and other Heat-Transfer Tubes.



THE GUSTAV WIEDEKE COMPANY
DAYTON 1, OHIO

For more data on advertised products, use Readers' Service Cards, last page.



306a

"Let's do an abstract,' said the artist for the hundredth time.
"You pipe down," we answered, "and let us get on with selling Darlington Insulation."
"Pipes!" cried the artist. "Now insulated pipes can't help looking abstract. It's the shape they are. Anyway, there's nothing abstract about insulation that cuts heat loss to only 10%. You've said so yourself hundreds of times."
So we let him do his abstract and here it is.

But we forced him to leave room for us to say that you will find Darlington Insulation saving money on pipes of all kinds—pipes for steam, for oil, and for many other basic materials of industry—all over the world. Our telephone number, if you'd like to know more, is NEWCASTLE 23666.

THE **DARLINGTON INSULATION** CO LTD

38 GREAT NORTH ROAD, NEWCASTLE UPON TYNE 2

Branch Offices in LONDON, BIRMINGHAM, BOLTON, BRISTOL, CARDIFF, GLASGOW, LEICESTER AND SHEFFIELD

A MEMBER OF THE DARLINGTON GROUP OF COMPANIES

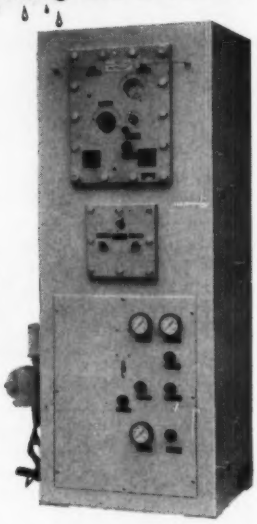
DETERMINE Moisture CONTENT

of **JET FUELS**
OILS
GASES
with the
MEECO UNIVERSAL MODEL W ANALYZER

to 0.0001 gram per liter of liquid
to 1 part per 1,000,000 of gas.

Direct reading scales — no computation necessary.

Write for complete information.



Explosionproof Universal Model W. (Other models including portable models for moisture in gas are available.)

MANUFACTURERS ENGINEERING & EQUIPMENT CORP.
Sunset Lane & York Rd. · Hatboro, Pa.
MEECO Instruments

TEST METERS IN STAINLESS STEEL

Specially made for the measurement of small volumes of gases and with special applications in the Petroleum Industry. Robust and easily cleaned.

Type E.40 Wet Meter, 1/10 cu. ft. per rev., 40 cu. ft. per hour, OR alternatively 2½ litres per rev., 1000 litres per hour. Stainless Steel case and drum.

PARKINSON COWAN
INDUSTRIAL PRODUCTS

PARKINSON COWAN INDUSTRIAL PRODUCTS
Cottage Lane, City Road, London E.C.1. Tel. Clerkenwell 1766/7

The instrument consists of a diaphragm mechanism in a pressure housing with pressure connections at the bottom, and a sensing coil which operates the remote receiver. The sensing coil is protected by a weatherproof cover. Cable connection to receiver is at right end of this cover.

The transmitter can be mounted at any convenient location. It is connected to the liquid vessel, fluid line, or other container by two tubes. At the transmitter, the tube connections lead to opposite sides of the diaphragm. Variation in the differential pressure on diaphragm causes change in output of sensing coil which is transmitted to the remote receiver.

The transmitter offers proved dependability, fast response, simple installation and broad range adjustment without altering or replacing working parts. Yarnell-Waring Co.

Circle E45 green card, last page

Pilot Plant Equipment Line Has Been Developed

A new line of products developed specifically for pilot plant operations, has been announced.

A pilot plant equipment manual has been compiled offering a complete line of standard columns, condensers, heat exchangers, pressure vessels, reactors, refrigeration equipment and tanks to assist in the design and development of these pilot plant or semi-works operations. Doyle & Roth Mfg. Co., Inc.

Circle E46 green card, last page

Exchange Uses One-Piece Cylinder Instead of Bundle

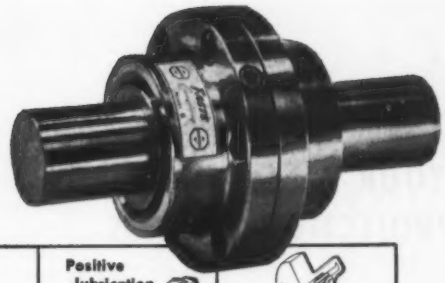
Improved "compression head" design is illustrated, and dimensions, capacities, and operating characteristics are pro-

Chemicals Wanted

The National Registry of Rare Chemicals, Armour Research Foundation, 33rd Federal and Dearborn Streets, Chicago 16, has received urgent requests for the chemicals listed below. If anyone has one or more, even if only one gram quantities, please inform the registry.

Cyclobutane
Benzenepentacarboxylic acid
1,2,3,5-Benzenetetracarboxylic acid (Prehnitic acid)
p-Chlorocumene
1-Chloro-2-methylbutadiene-1,3
2-Chloro-4-methylpentane
2,4-Dichloropentane
Dicobalto octacarbonyl
Dilauryl phthalate
3,3-Dimethyl-1-butanol
5,5-Dimethylheptene-3
N,N-Dimethyl phenylammonium iodide
2-Ethoxypropane
2-Ethyl-n-butyl chloride
4-Ethyl cyclohexanol
Furfuryl cyanide
N-Hexyl azide
2-Methyl-n-butyl chloride
Nonanol-5
Vinyl sulfide

FAST'S Model B Coupling



reduces downtime and upkeep for light-to-medium drives!

Now you can profit from the durability and economy of famous Fast's couplings in a smaller and lower-cost version—available in 5 sizes for shafts ½" to 3⅛" in diameter.

The Model B coupling gives you the same features that have made Fast's the world's leading coupling for over 35 years. You get the same trouble-free performance, longer service life and lower maintenance costs. You also get prompt delivery because stocks are on hand to meet practically every need. Free engineering service is also available.

Write today for more details to KOPPERS COMPANY, INC., Fast's Coupling Dept., 6103 Scott Street, Baltimore 3, Maryland.

Engineered Products Sold with *Service*

KOPPERS

THE ORIGINAL *FAST'S Couplings*

SAFE-SURE Liquid Level Control by LEVEL MASTER®

Here's your supply source for a complete line of standard and custom controls. Pictured is one of our Chamber Controls—an example of our broad line of standard units. We also specialize in custom controls of all types. The long-lasting magnetic proximity switch, incorporating a permanent Alnico V magnet, responds instantly to changes in liquid level.

- *Models for all types of liquids.*
- *Horizontal, vertical, external mountings.*
- *Precision engineered for long life operation.*

For full information consult your Level Master representative or write directly to:

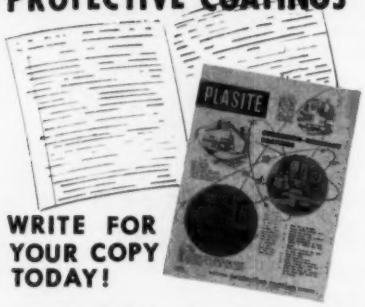
Jo-Bell Products, Inc.
5456 W. 111th St. • Oak Lawn, Ill. • Phone GArden 5-0240

Jo-Bell Products, Inc.
5456 W. 111th St., Oak Lawn, Ill.
Send full information on Level Master and name of nearest representative.

My name_____
Company_____
Address_____
City_____ Zone_____ State_____

Simplify

YOUR SELECTION OF PROTECTIVE COATINGS



WRITE FOR YOUR COPY TODAY!

- For Refining Process immersion service
- For Oil Production equipment
- For Heavy Spills and Fumes
- For Severe Atmospheres
- For Tankers and Tank Cars

PLASITE IS PROVEN BY LONG FIELD HISTORY IN

High temperature de-ionized tank lining.
Perco treater lining.
High octane gasoline and jet fuel tank lining.
Cooling towers, hot pipings, fans, and structural steel.
Exterior acid sludge tanks.
Sour crude storage tank lining.
Condenser heads.
Roofs of acid separators.
Concrete tanks, floors, sumps, and bases.
PLASITE Cold Set formulated Coatings from combinations of High Resistant Resins are economical to use.

OTHER PLASITE PRODUCTS INCLUDE: CAULKING COMPOUNDS
PRIMERS
BAKING COATINGS

WISCONSIN protective coating COMPANY GREEN BAY, WIS.
REPRESENTED IN PRINCIPAL INDUSTRIAL AREAS

PLASITE

Equipment

vided for all standard models from 21 to 470 square feet of heat transfer surface, in a new heat exchanger bulletin.

The Cross-Bore is a new type of corrosion-proof inpervious graphite heat exchanger which utilizes a rugged one-piece heat transfer cylinder instead of the normal tube bundle. It provides greater internal and external physical strength, accommodates higher working pressures and temperatures, and is particularly easy to clean. Falls Industries, Inc.

Circle E47 green card, last page

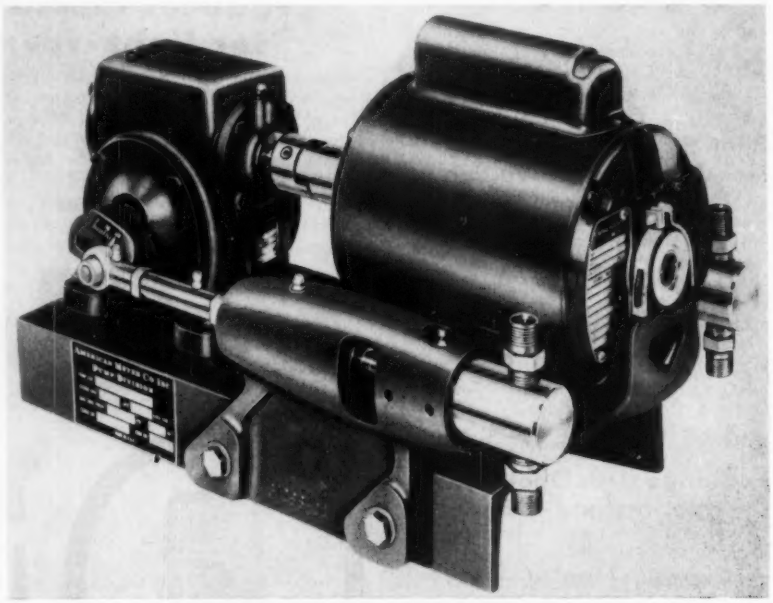
Preventive Maintenance Services Told In Brochure

A brochure covering preventive maintenance products and services, designed especially and specifically for petroleum refineries, has just been released.

The scope of products and services covers coatings for corrosion prevention ranging from sub-zero to highly elevated temperatures in the 2000 F plus zones.

Additional subjects covered are refractory protective coatings, chemical water treatments, solvent cleaning methods, soot, firescale and slag eradicators and chemical treatments for combustion and refining cycles. The Xzit Chemical Co.

Circle E48 green card, last page



New proportioning pump features low maintenance, easy capacity regulation.

Low Cost Proportioning Pump

Series 100 Simplex controlled capacity pumps handle capacities ranging from .65 gallon per hour to a maximum of 13.10 gallons at a maximum pressure of 1,000 psi. Duplex Series 100 models are rated at double the capacities of the Simplex models. Capacity regulation is easy and accurate. A screw on the crank adjusts the stroke while the pump is stopped. Stroke length is adjustable from 0 to a maximum of 1½ inches. Repetitive metering accuracy within a tolerance of ± 1 percent is obtained when the pump operates between the limits of 10 percent to 100 percent of stroke length.

Minimum restriction in flow is provided by ball-check column type valves with replaceable seats. These valves allow for the minimum requirement in net positive suction head. "E-Z" clean valves are available as optional equipment, for use with Series 100 pumps. With the latter type valves, piping need not be broken in the event that valves require cleaning or replacing.

All Series 100 pumps are driven by standard NEMA frame fractional horsepower motors. The electric motor is open, drip proof, single phase, 60 cycle, 115 volt. Motors with different characteristics can be supplied at extra cost.

In announcing the pump, the company described Series 100 pumps as "rugged, dependable, controlled capacity pumps for moving specific volumes of fluids wherever low initial cost, design simplicity, accuracy of control and minimum maintenance cost are prime requisites." American Meter Co., Inc.

Circle E49 green card, last page

PROCESS PLANT MAKER OF TOMORROW.....

Your plant engineering, fabrication and Construction probrems in Chemical, Petroleum, Petrochemical and nuclear fields ..... will be solved by CHIYODA's broad experiences in Engineering, Fabrication and Construction.

CHIYODA CHEMICAL ENGINEERING & CONSTRUCTION CO., LTD.

President: A. Tamaki

Tokyo Building, Marunouchi, Chiyoda-ku, TOKYO, JAPAN
Cable Address: "CHIYOTAKA TOKYO"

Ideco's portable H-40 Dual Rambler drilling rigs are credited with reducing the well completion time for Y.P.F. Argentina from 45 days to an average of 15 days. Yes, these dual trailer units really save time, and they withstand years of rugged field service. One example of the special features which assure long-life service from Ideco rigs is protection from corrosion.

The ten H-40's shipped from the U.S.A. to Y.P.F. were given the best corrosion prevention treatment available. Each unit was completely zinc coated, by hot-dip galvanizing or metallizing, at the Nowery J. Smith Co. Large structural parts not suitable for hot-dip galvanizing, because of size or dimensional stability requirements, were protected with special metal spray treatments by competent craftsmen. This extra protection means that Y.P.F. will get better than good service from its Ideco rigs for many years without fear of breakdown due to corrosion.

If corrosion is a factor in the work-life of your equipment, think Nowery J. Smith Co. Think Nowery J. Smith Co. for Hot-Dip Galvanizing • Metallizing • Pickling • Sand Blasting • Painting • Plastic Applications.

LARGEST HOT-DIP GALVANIZERS IN THE SOUTHWEST

NOWERY J. SMITH CO.

8000 Hempstead Highway • P. O. Box 7398
Houston 8, Texas • UNderwood 9-1425

One of the Smith Industries —

For more data on advertised products, use Readers' Service Cards, last page.

Advertisers in This Issue

PETROLEUM REFINER, MARCH, 1959

*The asterisk preceding name of advertiser indicates that detailed data on products and services of the firm will be found in The 1959 Refinery Catalog.

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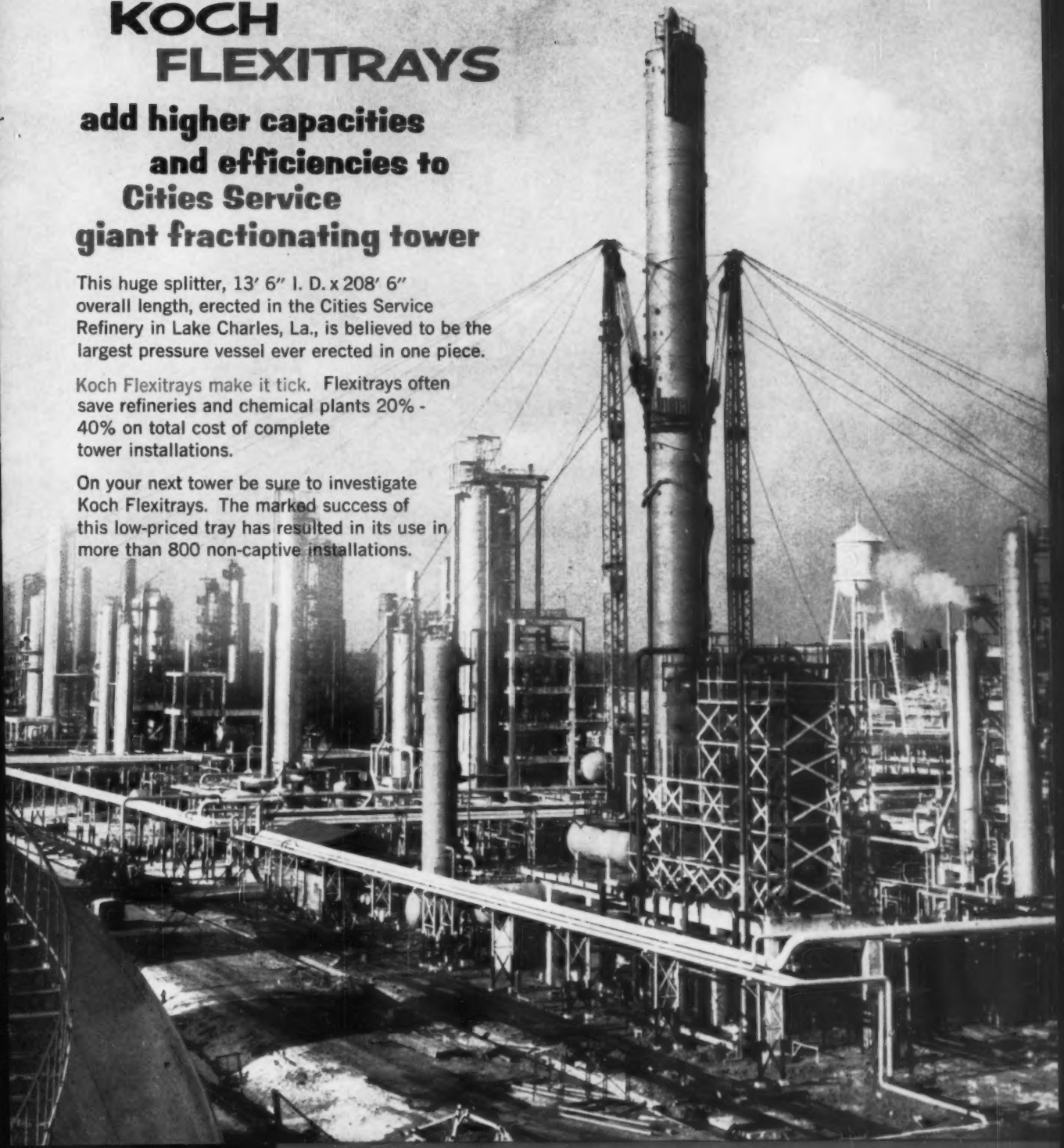

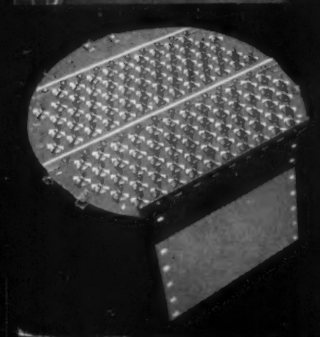

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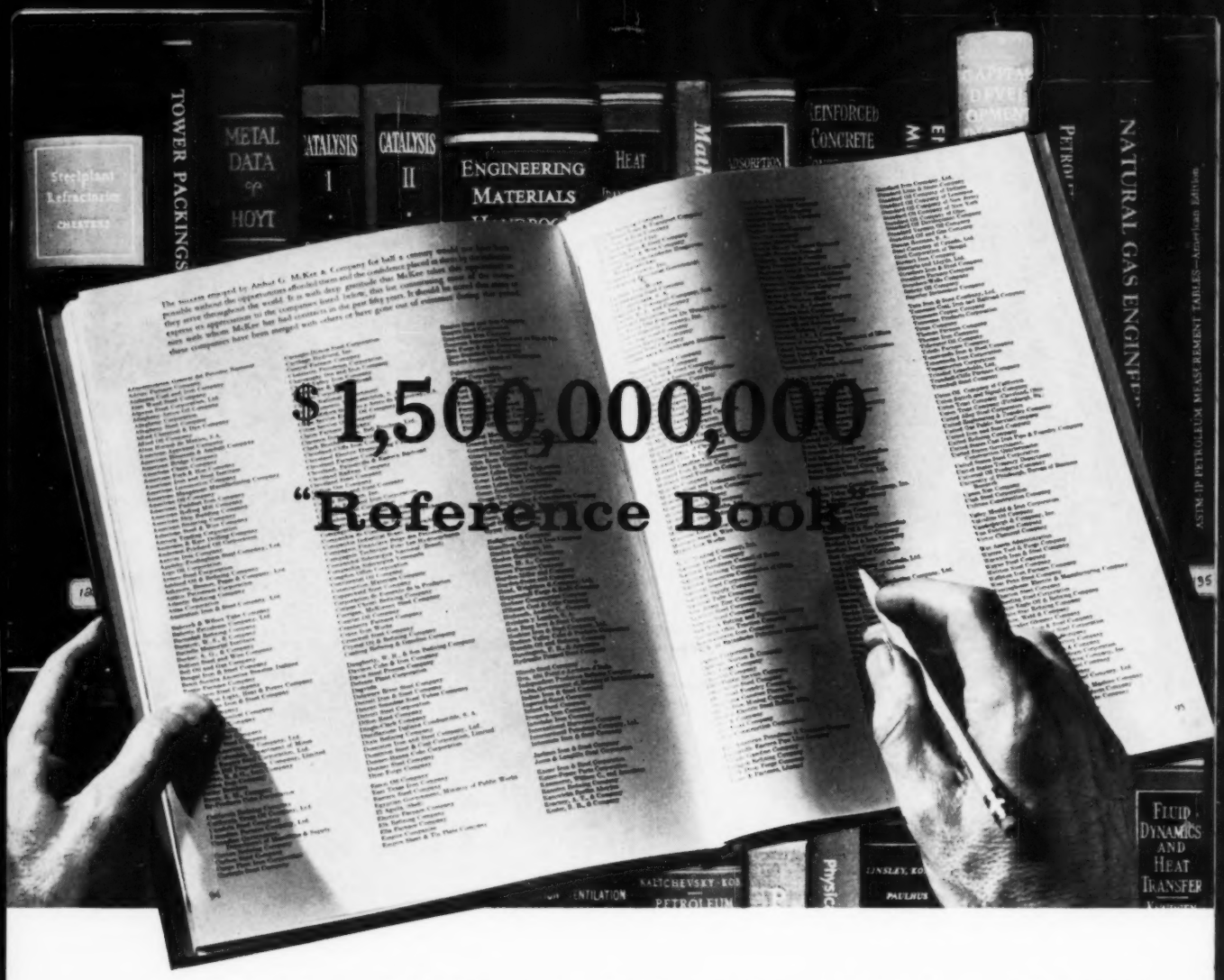

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